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Bert F. Hoselitz, Acting Editor

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THE HISTORY OF CITIES
IN THE ECONOMICALLY ADVANCED AREAS

1. Introduction

Though "cities" have existed in one form or another close on 7000 years, the past two centuries, 1750-1950, have witnessed an unprecedented urbanization of people and economic activity in areas affected by the industrial revolution. During this brief moment of history, many towns and villages in Europe and North America ceased to be mere regional markets for craftsmen and cultivators; they became vibrant centers for almost all the manufacturing, servicing, and distributive functions developed in an expanding economy. Only food raising and certain extractive processes remained tied to the countryside. The coincident growth of cities, population, and non-agricultural employments seems to have been a characteristic feature of all economically advancing societies.[1]

But the trend was not confined to western Europe and North America. During the first half of the present century, urban growth became more marked in some of the "underdeveloped" countries. Cities mushroomed in parts of the world which had previously felt little urban or industrial development; they expanded in areas of both high and low population density along the maritime fringes of Asia, Africa, and Latin America. The growth of urban population in Puerto Rico since 1898 is a dramatic illustration of this point. More recently there have been reports of urban-industrial concentration in some of the "sovietized" economies of eastern Europe and central Asia.[2]

These developments constitute a social transformation of which we know little beyond a bare statistical outline. It has been estimated that in 1800 less than 2 per cent of the world's population lived in cities of 100,000 or more inhabitants; by 1850 that proportion had perhaps reached 2.3 per cent;

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(1) The forthcoming volume by K. Davis and H. Hertz, The Pattern of World Urbanization (Macmillan), will be the first comprehensive study of urban demography since A. F. Weber, The Growth of Cities in the Nineteenth Century (New York, 1899); meanwhile we must be content with disparate evidence culled from official sources. Thus in England and Wales the proportion of economically active men aged 20 plus engaged in agriculture fell from 31.4% in 1841 to 6.1% in 1951: rural population as a whole dropped from a little over 51% to less than 20% in the same period. In the U.S.A. about 89.2% of total population lived in rural areas in 1840, but by 1950 that proportion had fallen to about 36%; the proportion of all persons aged 14 plus employed on farms in 1950 had declined to about 11.7% of total employment.

(2) For a discussion of printed sources and literature, see E. E. Lampard, Urbanization and Economic Growth: A Report to the Committee on Research in Economic History (mimeo, May, 1954), notes to Section 1.

in 1900 it stood about 5.5 per cent; but by 1950 it already exceeded 13 per cent. In view of the great increases in world population over this period, these changing proportions mark an enormous growth in the absolute numbers of contemporary (if not exactly "modern") city-folk.[3]

There are nearly 900 cities in the world today with populations over 100,000; in 1800 there were perhaps 20 of that size. By 1950 there were nearly 50 places with populations exceeding 1,000,000; in 1800 there were none. Nevertheless, of the great cities today "only about half . . . are located in countries whose level of socio-economic development is high enough to approximate that taken for granted by most writers on urbanism."[4] The mere presence of large cities in a region does not, therefore, ensure the existence of a developed economy. But it is no less clear that developed economies do not occur anywhere in the world without the presence of a large population, specialized away from subsistence agriculture, and residing in a "hierarchy" of different-sized cities ranging from one (or more) metropolitan centers at the peak to a broad base of medium and small-sized cities with less than 100,000 inhabitants.[5]

It is in the light of our own recent economic history, and that of the underdeveloped areas, therefore, that students of economic development have raised the question whether there can ever be widespread industrialization without concomitant growth of cities. We know, of course, from this same history that a few large centers may develop in a region without any marked industrialization. Many questions follow from these initial reflections. What has been the relation of urban development to economic growth in the past? Was the rise of the city merely a passive index or itself an active ingredient of industrial development? Did the economic advantages of urban-industrial concentration always outweigh possible disadvantages? Have cities in some way generated a dynamic force making for socio-economic change?

To some writers the connection between industry and the city was, perhaps, too obvious to require further elucidation. Others found a ready explanation at hand. The most common opinion was that cities were passive incidents in the growth and refinement of transportation systems. The great urban explosion of the second half of the 19th century was seen to stem directly from

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(3) Population Division of the Bureau of Applied Social Research, Columbia Univ., World Urbanization Index; Progress Report (mimeo, March, 1952).

(4) N. Rogoff, "The Universe of Cities: Some Preliminary Considerations," Bureau of Applied Social Research, Columbia Univ. (mimeo, Jan., 1953), gives an account of "the modernization index," a composite of the distribution of cities according to four interconnected variables -- literacy, urbanization, industrialization (non-agriculturism), and per capita income.

(5) The term "urban hierarchy" suggests a functional interdependence among cities; A. E. Smailes, "The Urban Hierarchy in England and Wales," Geography, XXIX (1944), 41-51; J. E. Brush, "The Urban Hierarchy in Europe," Geog. Rev., XLIII (1953); also the paper by R. Vining in this number.

improvements in communications which served to concentrate economic opportunities in locations which offered the greatest cost advantages in the procurement, processing, the distribution of goods. According to this view, cities developed at convenient nodal points in an evolving network of more refined transportation services. The revolution in transport transformed a relatively scattered and uniform mode of rudimentary activities into a highly differentiated but closely integrated system of local specialization.[6]

The concept of urbanization as an incidental phase in the growth of communications proved fruitful in many areas of research; but in some respects its very completeness militated against the development of other, supplementary, perspectives. If much was learned about the city, much that was important economically tended to be overlooked. Even the city planners sometimes neglected the "economic base" on which their designs for better communities would ultimately stand or fall. As Gordon Logie put it in a recent study of industry in towns: industry was regarded "as the bad boy of the class to be stood in the corner well away from commerce and housing." In an age of comprehensive, graduated transport services, people even questioned the necessity for living in cities at all. A genuine disgust at urban conditions combined with an ingrained rural romanticism to spread the popular belief that cities were "abnormal" and costly deviants from some natural, more verdant, order of socio-economic growth.[7] Even those who did concern themselves in a more disinterested way often failed to appreciate the intimate and complex relation of urban nucleus to environing economy. To be sure, the great schools of urban geography and sociology at Paris and Chicago did much to elucidate this question, but cooperation from theoretically-minded economists in such endeavors was seldom forthcoming. The work had to be carried on by others -- political reformers, architects, city-planners, demographers, human ecologists, and geographers.

All of this work was valuable but it did not, of course, concern itself with the role or significance of cities in the economy. Location theorists and land economists eventually threw more light on this problem; but they rarely went on to link their discussion of spatial factors to the more complex phenomenon of economic growth. It is significant, perhaps, that, though there are established fields of research in urban sociology, urban geography, municipal government and finance, no branch of economics yet studies the city in a comprehensive way. There are valuable items on the economic growth of particular towns, the whole area of medieval cities has provided a constant challenge to historians, but, to our knowledge, no systematic study has ever been made of the role of

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(6) F. Ratzel epitomized the process in the phrase: "Der Verkehr wirkt städtebildend," Anthropogeographie (2 Vols., Berlin, 1891), II, 464. See also L. Mecking, Die Entwicklung der Grossstädte in Hauptländern der Industrie (Hamburg, 1949), pp. 21-5. For a critique of this "transportation hypothesis" and its literature since J. G. Kohl, see E. E. Lampard, op. cit., Section 1, notes 9 and 10.

(7) G. Logie, Industry in Towns (London, 1952), pp. 19-25; E. T. Peterson, ed., Cities Are Abnormal (Norman, Okla., 1946).

cities in recent economic development.[8] We are still unable to counter the charge that cities are "abnormal" and "costly" with any considered account of the ways in which they have actually facilitated, let alone fostered, progressive economic change.

2. The Present Approach

Though this paper attempts some appraisal of the role of cities in the evolution of the economically advanced areas, it is not written in any confident departmental spirit. If I seemed churlish in commenting on the alleged shortcomings of others, it was not to imply that economic historians now bring some patent formula which enables them to fill existing lacunae or resolve every moot issue. On the contrary, any fruitful exploration of the city's relation to economic growth requires cooperation from every worker in the field -- from human ecologists and land economists to keepers of local archives.

I also recognize the special difficulty of generalization in the field of urban history. It has been said, for example, that cities developed in order to increase economic efficiency: to realize the optimal conditions of economy. But cities also provided a range of other social, civic, administrative, and psychological "services" -- each of which posed a different set of optimal conditions. Thus at various times and places cities were centers for religious and secular administration, communications, defense, recreation, and other community purposes in addition to economy. Each city, in fact, serves a variety of social purposes and meets an array of human needs. Yet no two are exactly alike in every respect of their functions; each is a more or less unique product of its individual history and circumstances. A city is a concrete manifestation of general social forces; but its identity stems from being a particular accommodation to them. Each city population attempts to reconcile its needs and purposes with the specific limitations of its culture and environment; limitations of size, resources, position, site, and technique. Our interest lies in formulating the generalities of urbanization in a way which may help in organizing and evaluating the diverse materials available in the history of particular cities.

Sir John Clapham has said that economic history treats the economic aspects of past social institutions and that its methodological distinctiveness among historical studies hinges on "its marked quantitative interests." Something more may be claimed on its behalf. Its materials may be selected and ordered in accordance with analytical schema drawn from economic theory. The economic historian may sometimes be in a position to emphasize potentially relevant factors in socio-economic growth which are not readily treated within the more rigorous confines of economic analysis. In the present case we are seeking to differentiate urban and non-urban influences relevant to some conceptual framework of economic progress.

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(8) The only comprehensive survey of the vast urban literature is E. Pfeil, Grossstadtforschung (Bremen, 1950), but this work is weak in respect of non-German material. Also, E. E. Lampard, op. cit., Section 1, Notes 12-16, for a discussion of urban bibliographies and historiography.

In such a reconnaissance as this a certain tactical license must be assumed in order to speed the assault on the final objective. Thus I did not linger long over the vexed question of definitions but proceeded to a survey of diverse materials from sociology, geography, and economics which might bear on our theme of cities and economic development. Two promising lines of approach were revealed. The first was to consider urban-industrial growth as a phase in the history of culture, as a cultural process. The second involved looking at urban-industrial growth as an economic contingency, i.e., as meeting fundamental conditions of economy or as realizing certain economic optima.

The second line of approach is familiar and more or less self-explanatory. The first may cause some difficulty. We will follow E. B. Tylor's celebrated definition of culture as "that complex whole which includes knowledge, belief, art, morals, law, custom, and any other capabilities and habits acquired by man as a member of society."[9] Such a broad formulation is not just another catch-all. It implies that modern urban-industrial society is an integral whole in which modes of life, values, and typical socio-economic relationships form a distinctive cultural pattern. A cultural approach has several advantages for the historian of the modern city. It enables him to treat the rise of an urban-industrial society as a whole, in all its interrelated aspects -- technical, administrative, social, economic, intellectual, etc. He can hope to avoid the worst errors of mechanistic determinism, since technology, ideology, and socio-economic institutions are alike integral parts of the cultural whole. Such an approach seems particularly appropriate in an evolutionary, historical study, for culture is a continuum of many interacting elements -- ideas and behavior, symbols and techniques. It is a process sui generis; a culturally ordered and transmitted whole.[10]

I shall first establish criteria of "economic progress" and develop a general hypothesis of the culture process linking modern urban and industrial growth. This argument is then checked against certain theoretical notions from economics and specific evidences from economic history. A final section

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(9) E. B. Tylor, Primitive Culture (5th ed., London, 1928), p. 5. C. F. Ware, ed., The Cultural Approach to History (N.Y., 1940), pp. 3-16, speaks of a cultural pattern which "conditions individuals, providing their basic assumptions and their tools of observation and thought, and setting a frame of reference for their living. It determines the forms of institutions, the types of conduct which will be sanctioned . . . Every culture acts selectively . . . stressing some characteristics, discarding others, and molding a culturally acceptable personality."

(10) A. A. Goldenweiser, History, Psychology, and Culture (N.Y., 1933), p. 59; L. A. White, The Science of Culture (N.Y., 1949), pp. 363-94; C. E. Ayres, The Industrial Economy: Its Technological Basis and Institutional Destiny (Boston, 1952), pp. 84-9; idem, The Theory of Economic Progress (Chapel Hill, 1944), pp. 187-88; C. Wright Mills and H. Gerth, Character and Social Structure (N.Y., 1954), pp. 375-404. But see also J. J. Spengler, "Theories of Socio-Economic Growth," Problems in the Study of Economic Growth, Universities Nat. Bur. Com. on Econ. Res. (mimeo, 1949).

suggests some "lessons" from our own experience for the so-called underdeveloped areas.

3. Cities and Economic Growth: The Role of Specialization in Cultural Change

(a) Assumptions regarding economy and economic progress: The word "economy" is commonly used to describe the social system which is concerned with the management and use of a community's resources. It also denotes the more efficient utilization of such resources in producing an output of goods and services. Economy, as Sargant Florence has suggested, takes output for granted and directs attention to costs.[11] Efficiency is the obverse of economy: it takes costs as given and focuses attention on return or output. Improvements in productive efficiency, whereby the physical output from a given input is increased, are held to enhance the community's potential for economic welfare.

Thus we find that real national output in the U.S.A. increased five-fold between 1900 and 1950, while population doubled in the same period. Output per head increased two and one-half times but the actual human effort expended -- as measured by total man-hours of labor input -- increased by only 80 per cent. Hence we conclude that the immense gains of the period reflect a fast-growing productive efficiency, or "unit efficiency of effort," in the American economy.[12]

Rising productive efficiency has, in fact, been the mainstay of material advances achieved in all the industrial areas of western Europe and North America. Increases in output per man-hour of work (the productivity increment) are generally recognized as the principal source of higher living standards. But it is not enough that goods and services be produced in greater magnitude and with greater efficiency; they must also be consumed and give greater satisfaction to their consumers. Any proper definition of "economic progress" requires that enhanced productivity be realized and sustained in higher average levels of consumption, after allowing for the maintenance of existing capital and adequate new formation.[13]

Some part of the amelioration of conditions in economically advancing areas is, of course, attributable to increases in the size of the labor force and the stock of capital. The major portion, however, has probably stemmed from increases in productive efficiency which, other things being equal, govern the rate of change in stocks of labor and capital. Moreover, of all the influences affecting productivity in advanced areas, the principal consists in improvements

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(11) P. S. Florence, The Logic of British and American Industry (London, 1953), pp. 48-55.

(12) F. C. Mills, Productivity and Economic Progress (New York, 1952), pp. 2-5.

(13) H. S. Davis, Economic Progress (Philadelphia, 1947), pp. 146-49; E. E. Lampard, op. cit., Section 2, notes 6 and 7.

in productive technique and organization which have the progressive effect of reducing the real costs of enlarged outputs.[14] Given the distribution of resources, the quantity and quality of capital equipment appear to determine the real cost of any output and, therefore, the possibility of progress.

These few considerations regarding means and sources of economic progress furnish an essential framework for the study of urbanization and economic growth. They provide a rough yardstick against which to measure the effect of changes in technique and organization. But how are such changes when identified as "improvements" related to the cultural phenomenon of city growth? The theory of economic progress as such throws little light on that subject. It mostly ignores social-institutional factors and is generally oblivious to considerations of "space" or area. Nevertheless, it does call attention to the dynamic influence of techno-organization itself.[15] We must therefore examine how such factors and considerations contribute to improvements in the level of techno-organization. We must enquire, for example, whether there are features of urban socio-economic structure and function which may affect such improvements. Are there features common to both technical and locational change which may link industrialization to the growth of cities? If so, in what ways do urban situations differ from non-urban situations in these respects? If particular urban sites and situations facilitate change, do all cities equally generate such a force, and, if not, why do they differ? Such questions bring us to the heart of our problem, but before they can be answered, it is necessary to look more closely at the cultural process of techno-organizational change.

(b) Specialization and improvements in technique: Technological developments are events in the evolution of cultures. They are an outcome of changes which, in greater or lesser degree, pervade every area of cultural experience, namely, innovation and emulation. The mechanical inventions of the last two centuries, for example, are a class of innovations representing new syntheses of technical and intellectual elements made available in the cultural stream of western Europe. As one recent writer put it: inventions are "those imaginative combinations which men make of previously existing elements in the cultural heritage and which have emergent novelty as combinations."[16] But for novelties to acquire any great socio-economic significance, they must, in effect, cease to be novelties. They must become generalized in, and characteristic of, their particular techno-organizational system.

The history of industrialism in Europe and North America vividly illustrates these processes at work. It shows the importance of antecedent elements

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(14) On the special importance of organizational as opposed to technological changes, e.g., new lay-outs, types of line production, multiple work-shifts, etc., see W. Baldamus, "Mechanization, Utilization and Size of Plant," Econ. Jnl., LXIII (1953), pp. 66-9.

(15) This is not to imply that the technological sphere of culture is autonomous or self-determining.

(16) B. Barber, Science and the Social Order (Glencoe, Ill., 1952), p. 194; also the opening chapters of A. P. Usher, A History of Mechanical Inventions (2nd ed., Cambridge, Mass., 1954).

in every "novel" technique: it emphasizes social-institutional factors which make an effective demand for their exploitation, e.g., the ideological and institutional concomitants of widespread capital accumulation. It helps explain the growing interaction of science, the useful arts, and economic institutions during the last three centuries. Finally, it throws light on the intense division and subdivision of labor which occurred in all areas affected by the industrial revolution. In short, industrialization was a phase of cultural history in which certain communities (and not others) became marked by an increasing differentiation of economic functions, skills, instruments, institutions, and regions.[17] It was this ongoing specialization among men and machines which gradually transformed the techno-organizational base of society and, with it, the spatial order of economic activities. Specialization provides an essential link between the technical and spatial conditions of economic progress. It holds an important clue to the nature and creative significance of urban-industrial growth.

(c) Specialization and the economy of resources and effort: I have implied that the division of labor is culturally determined but, from Adam Smith to the present day, most economic writers have explained it as having a purely mechanical relation to "the extent of the market." They have held that the degree of specialization at any time is a function of the size of the market; it depends on the volume of goods which the market can absorb, since the possibility of exchange is a necessary preliminary to any specialization.[18] There is much to be said for this formulation. Markets have certainly exerted a powerful influence on the potential division of labor. Constriction of trade or the prohibition of exchange have slowed the rate at which novel techniques could be adopted: changes in taste or shifts in demand have likewise created dissatisfaction with existing modes of supply and prompted innovation. All this is true; but to argue that A conditions B is not to establish A as the adequate cause of B.

The old dictum regarding the division of labor and the extent of the market was, to say the least, misleading in its simple finality. It repeatedly led economists to ignore or underestimate the "inner dynamisms" of specialization as a cultural process. For example, on one level of culture -- that of technique -- research may come to have a greater influence than markets on the course of specialization. On another level -- that of socio-economic institutions -- there may be strong inducements to specialization which themselves create wider markets.[19]

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(17) J. A. Hobson, The Evolution of Modern Capitalism (London, 1926 ed.), pp. 77-80; G. N. Clark, "Early Capitalism and Inventions," Econ. Hist. Rev., VI (1936), 149-53; J. D. Bernal, Science and Industry in the Nineteenth Century (London, 1954); B. Barber, op. cit., pp. 52-9, 191-206.

(18) A. Smith, Wealth of Nations (Cannan ed., London, 1904), pp. 6-14; G. Schmoller, "Die Thatsachen der Arbeitstheilung," Jahrbuch für Gesetzgebung, Verwaltung, und Volkswirtschaft, XIII (1889), 95-128; K. Bücher, Industrial Evolution (N.Y., 1901), pp. 282-314; L. Deschesne, "La spécialization et ses conséquences," Revue d'économie politique XV (1901), 155-62; F. von Wieser, Social Economics (tr. N.Y., 1927), pp. 310-14.

(19) C. E. Ayres, The Industrial Economy, pp. 88-91. Speaking of communities

Yet such heresies concerning process are not incompatible with much that is sound in orthodox accounts of specialization. The division of labor, for example, was always regarded as progressive when it contributed to productive efficiency. By concentrating a limited stock of energy or talent on one operation, each worker acquired greater skill and dexterity. Specialization along these lines fostered a more intensive use of tools and broke down all but the most complex muscular tasks to levels of simplicity where they could be mechanized. As a consequence, resources are saved for other employments and, to that extent, the productive potential of a community is raised. In theory, at least, each factor tends to find work for which it is best suited; for which it earns the highest return. The object of specialization, therefore, is a greater economy of time, effort, and resources -- the sources of higher productivity and material advance.

This emphasis on the "object" of specialization throws important light on the inherent dynamisms of the cultural process of division of labor. The very circumstances and incentives which make for specialization in the first place will, other things being equal, tend to foster its cumulative development. Specialization will thrive best where it is most developed. Specialization tends to breed specialization. It develops furthest where it is most prized; where socio-economic institutions are best adapted to its forms.

There is, as was suggested above, another sense in which "inner dynamisms" of specialization generate new specialization. For example, the growth of science in the last century had a potent "specializing" effect. A. N. Whitehead gave it the deceptively simple title -- the invention of "the method of invention." As a consequence of scientific advances, technical improvement has become, in part, the function of a self-motivating, self-controlling, technique called "research" which may be carried on without regard for the market.

In an urban-industrial society there is likely to be both wider opportunity and greater necessity for specialization than in earlier, more relaxed, modes of existence. In the city, for example, to specialize is to enjoy scarcity value, whereas in the country it is usually acquiescence rather than initiative which pays. An increasing rivalry for place and preferment under urban conditions puts higher premiums on more specialized roles, functions, and instruments.[20] Some may even make a specialty of "anti-specialism." Nevertheless, the specialist, the expert, the man with know-how and know-who, becomes a commanding figure in communities which have the income to buy his services. Professional achievement no less than private ambition impels the specialist to seek higher returns and greater security (scarcity value) in deeper, albeit narrower, ranges of specialism. It is no longer a matter of taste or inclination, but a condition of survival and fulfillment; a rule in the urban success game, a cultural norm. We might generalize and say that, in the

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with an industrial background, S. G. Checkland writes, "change seems to stem from technology almost as an independent variable," "English Provincial Cities," Econ. Hist. Rev., VI (New Series) (1953), 200.

(20) G. Simmel, "Die Grossstadt und das Geistesleben," in Th. Petermann, ed., Die Grossstadt (Dresden, 1903), pp. 187-206.

socio-psychological atmosphere of metropolitan existence, there is an inherent inducement, a "built-in" tendency, to specialize. The effort of entrenched groups and individuals to limit entrance in their particular fields is some measure of the drive to, and expectation from, specialization.

Thus the process is cumulative and dynamic, working at many interactive levels of particular cultures. Vast technical, economic, and emotional resources are invested in its behalf in every advancing economy. The outcome is always a more complex, potentially richer, more efficient order of life. Given the tendency to seek material advance through the unlimited application of science and technology to available resources and there is no end to this process of economic specialization. The ultimate outcome need not concern us here except to note that differentiation of functions and roles in a community "committed" to specialization raises a demand for more comprehensive and systematic coordination, if the object of greater economy is to be reached. Much of the saving realized in specialization, however, may later be used in developing new modes of socio-economic behavior and institutional structure to preserve the whole as a going concern, e.g., bureaucratization.

(d) Ecological consequences of economic specialization: If specialization makes for higher productivity over time, it also tends to concentrate productive activities over space. It is a dynamic process which transforms the spatial order of production and distribution. In pre-industrial societies, where factors are relatively unspecialized, economic functions and organizations tend to be uniform, simple, and scattered -- very much according to circumstances of geography.[21] The small urban nuclei which often develop in such societies are essentially service centers of an agrarian way of life. The services they provide have to do with religious and political administration, defence, the facilitation of mercantile exchange. To be sure, towns are sometimes centers for craftsmen, but the bulk of so-called primary and secondary activities remain undifferentiated in space and are tied to the "self-sufficient" hinterland where the mass of population perforce resides. Specialization revolutionizes the spatial pattern of economic activity and increasingly undermines the older social structure in so far as it is inseparable from a relaxed rural-agrarian base (the village and small market town).

The increasing specialization of functions, which marks an industrializing economy, imposes a greater measure of interdependence among the differentiated parts. Sometimes the interdependence is indirect (social) in the sense that everyone in the community now sinks or swims together. Individuals, firms, industries, whole areas rely on the general prosperity for their particular welfare and are more closely tied by some "common bond of stable

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(21) S. Kuznets, "National Income and Industrial Structure," Econometrica, XVII (1949), Supplement, describes a pre-industrial economy as one "in which a large part of production is within the family and rural community, a minor share of resources is devoted to advanced industrial production, and a minor part of its population lives in cities." An industrial economy is one "dominated by business enterprises, using advanced industrial techniques and ordinarily with a large proportion of its population in large cities."

interest." Direct interdependence, on the other hand, is ecological: it arises from the necessity of overcoming structural and environmental frictions which may impede the smooth, efficient, operation of differentiated parts. As a rule, the more specialized a function, the greater its dependence on other functions to keep it regularly and fully employed. Operational interdependence of this type requires more comprehensive cooperation and coordination of functions and areas, giving rise to more complex, "round-about" patterns of production.[22]

This ecological interdependence is essentially a centripetal force. To reduce operational imperfections and space frictions (which, from an economic standpoint, represent costs), interdependent specialisms tend to draw together and "link" in more integrated local sequences. Differential and complementary production requirements modify the geographical distribution of economic activity as greater advantages attach to local specialization. Production is increasingly concentrated in areas adjacent to workable deposits of coal, iron, and nonferrous ores, and at more accessible sites along the primary routes of trade; larger volumes of food, fuels, and other budgetary materials swell the burgeoning channels of commerce. The older balance between agricultural and industrial, rural and urban, populations is disturbed and regions of specialized activity emerge. From the strictly economic standpoint, local concentration is only limited by the physical distribution of resources and the costs of surmounting intermediate space (a composite of transfer charges and site rentals). It is this marked operational-structural attachment -- what J. A. Hobson called the "integrative tendency" -- which is at the root of urban-industrial concentration. The growth of the modern city and the march of the industrial revolution are joint products of a single cultural strand -- specialization.

The relation of functional specialization to the integrative tendency is seldom stated in this bald fashion: it doubtless needs some qualification as simplifying assumptions are removed. Nevertheless, its recognition is essential in a cultural-historical approach to the industrial city. There is, to be sure, a real sense in which specialization and integration can be represented as opposing forces, since differentiation often involves the disintegration of tasks formerly performed by one person, machine, or plant. But, by our definition, the specialist is one who provides a narrow range of goods or services; his specialty only achieves its profound economic significance as it is incorporated with, or absorbed in, the work of other specialists. We use the word "integrated" here to denote the fact that specialized operations must be fitted together, juxtaposed and joined, if the objectives of specialization -- greater economy of resources and effort -- are to be realized. It is precisely the task of an

(22) Cooperation and coordination not only transform spatial relations between economic functions but also foster "vertical," bureaucratic, structures of control. A. W. Hawley, Human Ecology: A Theory of Community Structure (N.Y., 1950), pp. 182-203, 371-404. L. Deschesne, op. cit., p. 162: "It (specialization) increases the interdependence of the diverse factors cooperating in a common production." F. von Wieser, op. cit., pp. 314-15, characterizes the division of town and country as "the historical result of the articulation of labor." See also G. Schmoller, op. cit., pp. 95-6; R. D. McKenzie, The Metropolitan Community (N.Y., 1933), pp. 50-65.

"economic system" to achieve this felicitous orchestration of diverse themes with whatever instruments a culture makes available.

Specialization of functions makes inevitably for specialization of areas: it prompts a territorial division of labor between town and country and differentiates town from town. Areal differentiation is, in fact, the spatial corollary of functional specialization and logically serves the same end -- economy. The closer integration of interdependent functions means that less of a community's limited stock of energy and material need to be devoted to overcoming the various disutilities of distance. Local concentration of specialized activities is thus an ecological response to certain technical and cost considerations which impel a more selective use of space, a more efficient pattern of land-use. In varying time and degree, technical limitations on power transmission, the state of the arts, the linking of processes, more effective communications, better procurement of materials and skills, closer control over business functions, readier access to markets, etc., have all transformed the spatial pattern of economic activity. From a socio-ecological standpoint, city growth is simply the concentration of differentiated but functionally-integrated specialisms in rational locales. The modern city is a mode of social organization which furthers efficiency in economic activity.

4. The Economics of Urban Growth

(a) The logic of space economy: location analysis and land economics: The cultural approach to urban-industrial growth sketched in the preceding pages is not inconsistent with certain approaches of economic theory. Thus the effort involved in surmounting spatial frictions in the economy can be visualized as a sum of physical inputs which represent a charge on scarce resources. Resources utilized in overcoming such imperfections are, by definition, no longer available for alternative uses: the "mobility" of factors and products always involves some cost contingency. In the interests of economy, therefore, "distance inputs" should be minimized, except where their substitution for other inputs brings a higher return. These spatial problems of economy are most readily treated with the techniques of location analysis and land economics and, as Walter Isard has shown, such an approach adds an important dimension to conventional production theory: it focuses attention squarely on the spatial aspects of economic activity.[23]

The optimum location for any enterprise is determined by striking a balance of all possible sites in terms of differences to be achieved in operating cost (including site rent) plus differences in transfer cost. A rational choice of site should represent the most advantageous locus for the given type of activity in the light of all existing business conditions and prospects. Similarly, consumers should locate themselves so as to minimize the proportion of their income spent in the "consumption" of transport services and

(23) W. Isard, "The General Theory of Location and Space Economy," Quart. Jnl. Econ., LXIII (1949), pp. 476-506. For a brief review of location literature and a caution regarding the role of transport in locational change, see E. E. Lampard, op. cit., Section 1, Notes 9 and 10, Section 3, Note 2.

other "distance inputs." The indiscriminate siting of production and consumption may result in charges on the economy no less serious than the employment of wasteful production-functions. Thus, if all producers and all consumers were located in one place, maximum efficiency of location would be achieved; no resources or effort need be devoted to surmounting disutilities of space.

But the actual location of activities at any time, like the level of technical efficiency itself, is deeply rooted in past history and present circumstances. The pattern never approaches the high order of rationality sketched in the previous paragraph. Nevertheless, the geographical distribution of activity is rational to the extent that, given the natural disposition of materials and the level of the arts, all output is secured at a minimum cost to the community's limited stock of resources and energy. The rationality of an economy, as Professor Hoover has shown, "can only be understood in terms of the interrelations among units of production."[24]

In a culture which emphasizes the virtue of economic competition, there will be a continuing tendency for producers to scatter or concentrate according to the principle of minimum cost. Conventional production theory has led many to suppose that economies of scale and mobility of factors would eventually bring all activities into great centers, but the persistence of small-scale plants and widely dispersed towns is not necessarily a token of irrationality. It may merely indicate, for example, that transfer costs to scattered markets cannot immediately be offset by economies of large plant operations. Similarly, as we shall argue later, the clustering of smaller plants in particular localities yielding "external" economies may provide a viable alternative in some lines to the highly centralized large-scale operation yielding mostly "internal" economies.

From time to time the economic historian notices substantial changes or shifts in the location of activities, changes which often defy simple explanation in terms of comparative cost. Many short, medium, and long-run influences determine these historical movements: the growth of population, the depletion or discovery of resources, the force of technical improvement, alterations in the level and distribution of income, the course of the trade cycle, etc. But few of these currents work in the same direction simultaneously or with equal force. The most that can be said is that countervailing tendencies in an advancing economy should evidence a more rational distribution of activities over time. There is a presumption that the more salient shifts in the history of economically advanced areas will mark responses to the "pulls" of progress. Notwithstanding difficulties in the measurement of locational change over long periods, studies from at least two advanced areas, Great Britain and the United States, broadly confirm this expectation. The long-run trend has been towards local concentration.[25]

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(24) E. M. Hoover, "The Location of Economic Activity," in H. F. Williamson, ed., The Growth of the American Economy (N. Y., 1944), pp. 580-85; C. Woodbury, ed., The Future of Cities and Urban Redevelopment (Chicago, 1953), pp. 118-43.

(25) E. M. Hoover, The Location of Economic Activity (N.Y., 1948), pp. 145-85; A. J. Wensley and P. S. Florence, "Recent Industrial Concentration,"

Robert Murray Haig was perhaps the first economist to adapt location analysis to a general theory of urbanization. In two articles published during the mid-twenties he offered an explanation of urban growth and a rationale of the internal economic arrangement of cities. He argued that improvements in communication services had reduced the time and cost involved in factor movements and had increased the over-all capacity of the system. These considerations led him to develop the model of a "frictionless" distribution of economic activities.[26]

As Haig saw it, "(t)he most favored spots are those from which the richest resources can be tapped with the lowest transportation costs." In an industrializing economy, moreover, a diminishing proportion of the labor force is required for primary production and a correspondingly larger proportion "is under no compulsion to live 'on the land'" But if this "economically foot-free" population is to earn a living, it must reside in places where it can obtain work; in places where opportunities exist in manufacturing, distribution, and related business functions and where consumption goods can be supplied in quantity at lowest cost. "Instead of explaining why so large a portion of the population is found in urban areas," declared Haig, "one must give reasons why the portion is not even greater. The question is changed from 'Why live in the city?' to 'Why not live in the city?'" All activities apart from basic food-raising, extraction, and long-distance transport should remove to the nearest metropolis: there could be no economic reason for anyone to live or work far from the great city.

Haig knew this to be an extreme position, yet he meant it to exhibit the rational possibilities of a territorial division of labor based on the tested principles of location analysis. Despite all qualifications required by the facts of life, his argument showed that cities were, from a standpoint of transfer efficiency, optimum points for production and consumption. While conceding certain diseconomies and "consumption advantages of non-urban locations" in particular cases, Haig made urban-industrial concentration the first premise of his spatial logic.[27]

The internal structure of urban land-use was likewise conditioned by the controlling circumstance of spatial frictions: the physical task of surmounting imperfections at minimum cost. Within the city, however, transfer charges were only one of two principal friction costs: the other was site rental. All urban enterprisers must therefore take account of the costs of assembling their materials and merchandise and the costs of their employees' journey to work. The retailer must reckon with an additional factor, namely, the travel costs of his customers who come from all around to shop. It was the convenience of customers which, according to Haig, looms largest among

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Rev. Econ. Studies, VII (1940), 139-58; A. C. Hobson, "The Great Industrial Belt," Econ. Jnl., LXI (1951), 562-76.

(26) R. M. Haig's articles from the Quart. Jnl. Econ. (1926) were reprinted in Major Factors in Metropolitan Growth and Arrangement (N.Y., 1927)

(27) R. M. Haig, op. cit., pp. 21-2, 37-9.

considerations affecting retail locations and which explains why high rents are paid for the most accessible sites. It also helps explain why modern department stores sometimes seek locations in suburban sections along the perimeters of great cities.

Haig concluded that every businessman should seek the site for which the sum of his friction costs was lowest. In the absence of "artificial" restrictions, he thought that competition would ensure that the activity which capitalizes most on the locational advantages of a site would occupy it; that which exploits the locational character of the site most efficiently. In last analysis, the residents of the community, the customers, determine the pattern of land-use, the "grain" of the city, through the evaluation of site-attributes expressed in their purchases. Thus the most efficient lay-out for a city would be one in which the total of land-values was lowest; efficiency being inversely proportional to the sum of all costs of friction.[28]

Haig's contribution to the logic of space-economy was immense. He developed a theory which showed urban growth to be part of a great rationalizing process in the industrial society and he indicated some of the obstacles and frictions which frustrate the realization of more rational patterns of land-use. The economic historian of cities must be eternally grateful to Haig since much of his time is spent in tracing divergences between economic logic and historical fact. Sometimes the situations which offend theoretical logic, however, have what Sargant Florence called "a practical logic" of their own.[29] For example, the theory of maximizing returns at minimum cost indicates an economy of large-scale operations in large plants, but in practice the logic must often be modified "by reason of technical, distribution, and risk factors. The facts often diverge even from this practical logic, a divergence attributable either to a logical producer having to cope with an illogical situation, or to his own illogic, or both."

Yet when all qualifications on rationality are admitted, the evidence of economic history affirms the continuing vitality of localized concentrations of industry within an expanding economy. What then are these potent economies of urbanization which tend to overcome all but the most stubborn of geographic and social circumstances? Why hasn't some principle of diminishing returns to concentration compelled a drastic decentralization and a decline in the size of our leading industrial centers? Why, on the other hand, isn't everything by now completely centralized according to the Haig model?

It is precisely because urban sites offer an array of "scale"-type economies almost regardless of actual plant-size that concentration endures. For example, better transfer facilities, broader and more flexible labor markets, numerous auxiliary business services like banking, insurance, brokerage, utilities, or fire and police protection. To these may be added

(28) Ibid., pp. 43-4, especially "Economic Basis of Zoning."

(29) See R. U. Ratcliff, "The Dynamics of Efficiency in the Locational Distribution of Urban Activities," Columbia Univ. Bicentennial Conference I (Jan., 1954, mimeo), pp. 5-14. P. S. Florence, op. cit., pp. 92-7, 339.

increasing returns to larger operations, various economies of integration (used here in the sense of control), bulk purchase and handling, complementary factor requirements, greater density and frequency of customers: in short, most of the advantages of scale-economy and greater specialization.[30]

The fact that many activities, especially those of a service nature, have low "coefficients of localization" does not mean that urban incentives have lessened, as such a low coefficient does not indicate that the function is better situated in a non-urban locale. We find that bakeries, building supplies, road trucking, and banking have a characteristically wide geographical distribution in many of the advanced economies. Yet none of them could properly be classed as a "rural" activity, nor does the smallness of their particular operation preclude membership in a large-scale organization, e.g., the joint-stock banks in Britain. Similarly, iron, steel, and shoe industries tend to integrate in certain localities, while others, such as the branches of electrical engineering, scatter and differentiate with population itself. Wherever income is created on a sufficient scale locally, such activities will thrive, despite the fact that more specialized forms of the same activities may favor a central or metropolitan location. It can be said, therefore, that either through the nature of their product or the character of their materials, some activities remain tied to relatively scattered sources or dispersed markets.[31]

Broadly speaking, we can say that "economies of urbanization rest on the same basic principles as those of the individual producing unit: multiples, massing of reserves, and bulk transactions."[32] Diminishing returns to concentration merely set some limit to any particular agglomeration, to the economies derived from some individual site. In most areas diminishing returns do not seem to have affected the long-run trend to urbanization.[33] Large cities, in fact, grow larger (on the perimeter).

(b) External economies: the economies of urban atmosphere: The study of locational changes makes an important contribution to our knowledge of the city's role in economic development. It establishes the broad rationalizing effect of concentration and, to that extent, supports the hypothesis that urbanization of economic activities tends to facilitate progress. Yet it does not develop the full implications contained in some of the axioms of location theory; implications which, we believe, bear on the "creative force" of cities. Using

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(30) E. M. Hoover, op. cit., pp. 116-41; P. S. Florence, op. cit., pp. 85-8.

(31) The coefficient of localization is based on the deviation of the distribution of workers in industries or areas from the distribution over the whole industry or country; A. J. Wensley and P. S. Florence, op. cit., pp. 139-55. Also P. S. Florence, Investment, Location, and Size of Plant (Cambridge, 1948), Tables IVB, IVN.

(32) E. M. Hoover, op. cit., pp. 120-21.

(33) P. S. Florence, "Economic Advantages and Disadvantages of Metropolitan Concentration," Columbia Univ. Bicentennial Conference I (Jan. 1954, mimeo).

ideas which have since become common ground among location analysts, Alfred Marshall was able to provide a somewhat broader perspective on the role of cities.

In Book IV of the Principles, and again in Industry and Trade, Marshall emphasized that not all gains from concentration were attributable to large-scale operations. Some additional savings, he thought, were derived from "the aggregate volume of production of the kind in the neighborhood." To the "internal" economies of scale (ultimately derived from managerial capacity and the volume of business), he added certain "external" economies which stem from the "industrial atmosphere" of individual towns (he had Sheffield and Solingen in mind) and "yield gratis to the manufacturers . . . great advantages that are not easily to be had elsewhere."[34]

Thus far his views do not differ markedly from those of the location analysts. If less rigorously formulated, however, his statement is the more evocative; he goes on to suggest that the "atmosphere" or socio-economic structure of towns generates a powerful force for innovation and change.

Two things had especially impressed Marshall as he considered the changing location of industry and commerce in the Britain of his day. (1) He noted that once an industry develops in an area, it is prone to stay there a long time -- "so great are the advantages which people following the same trade get from near neighborhood to one another." (2) The existence of strong local roots seemed a powerful stimulus to innovation and change:

> "Good work is rightly appreciated, inventions, and improvements in machinery, in processes and the general organization of business have their merits promptly discussed; if one man starts a new idea, it is taken up by others and combined with suggestions of their own; and thus become the source of further new ideas. And presently subsidiary trades grow up in the neighborhood, supplying it with implements and materials, organizing its traffic, and in many ways conducing to the economy of its materials."[35]

Each new synthesis, so to speak, becomes a potential matrix of a new development.

Marshall was likewise one of the first to hint at a theory of local transformation. As the old center continued to beget or attract other manufactures and related trading activities, there was increased competition for central sites, since "contacts" were essential to the conduct of modern commerce. The newer factories tended to drift to the outskirts or even move to adjoining towns where land was cheaper and producers might enjoy higher returns to

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(34) A. Marshall, Principles of Economics (2nd ed., London, 1891), pp. 325-32; idem, Industry and Trade (London, 1919), pp. 284-87.

(35) Ibid.

scale. The whole urban district thus offered a continuing opportunity for further adaptation and specialization; "the mysteries of the trade . . . are as it were in the air, and children may learn them unconsciously." Meanwhile, the predominance of artisans in the town center gradually gives way before the swarming of clerks, salesmen, and wholesalers. Despite the onset of maturity, the dynamism and creativeness of old centers remained impressive. In face of vast technical changes, the old industrial towns maintained vitality and adaptability, quickly turned to account new departures in technique, and often attracted "new shrewd energy" to their midst.[36]

Marshall did not, of course, formulate a theory of urban-industrial growth. The gleanings of his wisdom gathered here are scattered through two major books and three decades or more of careful observation and reflection. Yet his remains the boldest, most imaginative, account of urban influences to appear in the literature. Unfortunately little has been done to test his generalities with empirical studies. For example, the putative relation between "external" economies of atmosphere and the emergence of novel technique has never been adequately explored. Indeed, the whole subject of "external" economies remains a rather large "empty box."

Some have argued that "external" economies are a will-o'-the-wisp affecting "a very small proportion of the total costs of an industry," and therefore have no significant influence on the rate of return (diminution of cost). This may be true in part but it does not permit our writing off the strategic importance of such a proportion, however minute it may be in comparison with total costs. Conceivably, the "external" economies might just provide the competitive difference between two or more locations with otherwise identical procurement and transfer costs.

E. A. G. Robinson made a useful distinction between mobile and immobile "external" economies: between those accruing to whole industries and those confined to localized plants or firms.[37] From the history of Lancashire's cotton industry he inferred that the proportion of "external" economies "of the international mobile type" is steadily increasing at the expense of the immobile variety. In other words, the economies of local concentration were to this extent lessened and the optimum size of local industry correspondingly reduced. Yet, he implied that the newer, more remote, subconcentrations of cotton manufacture, such as those in Central India, were likely to remain dependent on the older Lancashire concentration "for developments of machinery, of techniques, and of fundamental research . . ." If these three contingencies alone exhausted the influence of centers with immobile "external" economies, they would still be of great significance for progress. A backward area developing certain segments of its manufactures for the first time may well find the absence of such economies a serious handicap, and almost certainly a drain on limited capital resources.[38]

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(36) Ibid.

(37) E. A. G. Robinson, The Structure of Competitive Industry (Cambridge, 1931), pp. 140-44.

(38) W. J. Baumol, Welfare Economics and the Theory of the State (Cambridge,

The case for immobile economies receives further force from the study of their influence on plant-size. Some local economies even outweigh advantages derived from lower transfer costs in procurement and distribution. Small and medium-sized undertakings prove viable in certain local situations and are not impelled towards larger, more centralized, operations. Such economies are occasionally decisive influences in location. For example, Sargant Florence has spoken of their significance in regard to

> "the possibilities of division of labor between plants in 'linked' processes, products and service industries. The advantage of full use of specialist plants can be combined with proximity. Several specialized plants, if close enough together, may have much the same economies as the separate departments of a large plant . . . a given scale of production by several small firms will undoubtedly offer more points where the powerful profit incentive is applied than a large plant with a salaried servant of a joint stock company in charge."

Thus "external" economies arising from special features of localized concentrations of industry may have a critical importance for the general profitability and development of business enterprise.[39]

Allyn Young once postulated a significant connection between higher returns from specialization (internal and external economies thereof) and general economic progress. He noticed that, with every increase in industrial differentiation, new opportunities for specialization occurred and new advantages attached to it. Though elasticities of demand and supply varied for each line, there was a real sense in which new divisions of labor in one sector might stimulate developments in related sectors. Little was ever done to put these bold ideas to the test, but, in so far as such theorists as Marshall, Young, and Jones attributed an "external" character to so many of the economies of expansion,[40] there seems justification for insisting on some investigation of the urban hypothesis. There is ample evidence in the study of locational trends in Britain, Germany, and the United States to suggest that the economic advantages of urban-industrial concentration still outweigh the sum of the known disadvantages.

(c) Economic progress and the growth of tertiary activities: In earlier sections I suggested that the progressive differentiation of work which underlay urban-industrial growth had proven a powerful stimulus to tertiary activities. As technical advances augmented productivity in agriculture and manufacturing,

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Mass., 1952), pp. 165-66.

(39) P. S. Florence, The Logic of British and American Industry, pp. 85-8; West Midland Group, Conurbation, Ch. 8; E. E. Lampard, op. cit., Section 3, Note 20.

(40) A. A. Young, "Increasing Returns and Economic Progress," Econ. Jnl., XXXVIII (1928), 529-39; G. T. Jones, Increasing Return (Cambridge, 1933), pp. 5-27, 245-48; A. G. B. Fisher, "Capital and the Growth of Knowledge," Econ. Jnl., XLIII (1933), 379-81.

a growing proportion of the labor force was freed to engage in other so-called "tertiary" occupations -- defined by difference as "all other activities producing a non-material output." More recently, the development of self-service merchandising, automatic elevators, adding machines and computators, and the craze of "do it yourself" gadgets, marks a tendency for technical change to invade labor's preserve in the "service" industries.

But if some such transfer of workers into the tertiary area had not occurred in the past, the worst prophecies of the early machine-breakers might have been fulfilled. The numbers of technologically-displaced persons would soon have hobbled labor-saving innovation and lessened the desirability of "progress." That our society has never been wholly disenchanted with "progress" is due, in large part, to the proliferation of tertiary employments. The shift from agriculture and manufacturing has no doubt been painful for those caught in times of rapid techno-organizational change, but the great increases in wealth accruing to communities from their enhanced productive capacity has provided both a cushion and a rationale for the change. It is precisely this prospect of greater productivity which draws people of underdeveloped areas towards the industrial revolution. One hopes that the social costs of industrialization will not prove a rude awakening.

A. G. B. Fisher has described the process in this way: as wealth increases after an indeterminate point, new demands are made effective in the direction of products requiring relatively less capital and relatively more labor as compared with other products. In short, the higher a community's income, the greater the demand for tertiary products. In its (over)simplest form, the argument may be stated: economic progress is accompanied by a rise in the percentage of the labor force occupied in tertiary production.[41]

Despite the many difficulties in definition which complicate the statistical task of measuring tertiary employment, there is a volume of general evidence from the history of advanced economies to support this hypothesis. For example, it appears that the larger an individual's income above subsistence, the higher will be his marginal propensity to consume such tertiary items as travel, education, amusement, domestic service, and even research. Similarly, the marginal propensity to consume tertiary products at all levels of income exceeds the average propensity. Progress produces large, albeit unequal additions to income at most levels of society, and it is broadly true that all levels, except the very lowest, tend to increase their consumption of tertiary items correspondingly. Tertiary production, moreover, appears to have furnished an increasing share of the total value of national output in the more advanced economies; while labor productivity has risen more sharply in primary and secondary occupations than in tertiary. Hence, despite the difficulties of measurement, we conclude that most tertiary items have a higher income-elasticity of demand than most non-tertiary items; and that technical development has proceeded, at least until very recently, at a slower rate in tertiary than in other sectors. The expansion of specialized tertiary employments thus seems a useful index of a progressive economy, though it is by no

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(41) A. G. B. Fisher, loc. cit., pp. 379-85; idem, Economic Progress and Social Security (London, 1946), p. 57.

means certain that the experience of underdeveloped societies must necessarily follow this exact pattern.[42]

If the growth of tertiary employment may be regarded as symptomatic of progress, it is significant that it also points in the direction of the city. Primary activities are best located where resources abound; near fertile farm land, in great forests, or on rich ocean banks. Secondary production is most advantageous in or about industrial centers, or at points variously distant -- depending on frictions of bulk or perishability -- from suppliers of materials and consumers of products. The area of tertiary activities, however, is even more confined in that its product is closely tied to a consuming population which is overwhelmingly urban or suburban. As Colin Clark has suggested, the city is the only feasible locus for the mass of specialized servicing.

The proportion which tertiary bears to total employment and income in a locality provides a useful tool for the study of city growth and size. At a given average level of income, a population might wish to consume a variety of tertiary services, but if no urban center exists in the vicinity, it is unlikely that people will be able to meet their expectations. They must do without them or make a periodic pilgrimage at personal cost to the nearest regional center. Clark argued that "(a) city cannot be said to be of optimum size unless it can provide its own inhabitants and the inhabitants of the surrounding region with at any rate all but the most specialized . . . services."[43] His argument shows that the "proper" amount of service employment in a locality should vary with the income of that locality. Though accurate figures on urban income were not available, he took some localareas given in the United States, British, Canadian, and Queensland census tables in order to compare numbers employed in service industries per million dollars of "regional income" with the national average in each case. When the volume of tertiary employment per million dollars of local income fell below the national average, the size of the central city in the locality was adjudged below the economic optimum. It could not attain sufficient specialization to give the area the range of services which, on the basis of income, the population would wish to purchase.

Where city population ranged between 100,000 and 200,000, inhabitants of the immediate vicinity might expect an adequate array of commercial services. For most other activities -- education, domestic help, government, "body and clothing" services, etc. -- a somewhat smaller central population would suffice. We need not be concerned with these details, but the broad implications of the argument are important. The principal function of the city today in terms of the employment it creates is the provision of services rather than manufactures. This is not to say that manufacturing no longer

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(42) See literature cited by S. G. Triantis, "Economic Progress, Occupational Distribution, and International Terms of Trade," Econ. Jnl., LXIII (1953), 627-37; E. E. Lampard, op. cit., Section 3, Notes 22, 23, and 24. But see P. T. Bauer and B. S. Yamey, Econ. Jnl., LXI (1951), 741-55; ibid., LXIV (1954).

(43) C. Clark, "The Economic Functions of a City in Relation to Its Size," Econometrica, XIII (1945), 97-8; P. S. Florence, op. cit., p. 86.

imposes its essential location requirements. Despite some relaxation of these requirements in the present century, Clark found manufacturing concentrated in the established centers of industry much as they were in Marshall's day. Only the proportions of the labor force had changed somewhat with the trend set towards servicing.[44]

5. The Economic History of Urban-Industrial Growth

The development of the industrial city is a phenomenon of the last two centuries. In 1800 the percentage of United States population living in places of 8,000 or more inhabitants was under four. For Europe, with the exception of Britain and the Netherlands, the percentage was not much larger, and in no case did it exceed twenty-one. In all Europe at that time there were perhaps 300 towns with populations exceeding 10,000; in the United States less than half a dozen. Europe had about 21 cities exceeding 100,000 in population; not one had yet reached 1,000,000. There may have been a few centers in Asia which exceeded 100,000 at the time, but none in Africa, Australia, or the Americas.

By the early 1950's well over half the people of western Europe and North America were classified as "urban" in their respective census returns, and there were nearly 900 cities in the world exceeding 100,000 inhabitants. A third of these were located outside of Europe and North America. But as recently as 1900, the Millionenstadt was a rarity. In 1950, however, London and New York were no longer freaks; nearly 50 cities had 1,000,000 plus populations; already 12 exceeded 3,000,000.[45]

The history of urban-industrial growth mirrored in these figures falls conveniently, if somewhat artificially, into three phases. The first or preindustrial phase was coming to a close in several parts of Europe and colonial America towards the end of the 18th century. The second or industrial phase developed rapidly during the second quarter of the 19th century and extended down to the present century when it merged into a third or metropolitan phase.[46]

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(44) Ibid., pp. 112-13; K. S. Lomax, "A Criterion of Efficiency in Local Administration," Jnl. of Royal Stat. Soc., Series A, CXV (1952). W. W. Rostow, The Process of Economic Growth (N.Y., 1952), pp. 22-54, identifies six propensities affecting growth -- to develop fundamental science, to apply science to economic ends, to accept innovations, to seek material advance, to consume, to have children. All except the last are characteristic propensities of the industrial city.

(45) The rate of urban increase is often greatest in areas of recent development: in some cases such areas have passed rapidly from a preindustrial to an advanced economy. In Victoria, of nearly 750,000 new State residents, 1900-50, 90%, immigrant and Australian-born alike, now live in Melbourne. In New South Wales, Sydney has tripled its population since 1900, while the State has only doubled in size. Size, however, is no index of development, e.g., in 1890 Los Angeles, Karachi, and Buenos Aires were still "large villages."

(46) The phases correspond with those described by Patrick Geddes as: eotechnic, paleotechnic, and neotechnic; Cities in Evolution (London, 1915).

Today all economically advanced areas are in the third phase, though most parts of the world are still in one of the earlier phases. Within each phase, however, there is enormous diversity of society and economy. History and circumstances always combine to impose their stamp differently on each particular city as its inhabitants strive to achieve their various cultural objectives -- political, economic, administrative, military, etc.

(a) Preindustrial urbanization in Europe. We shall not be detained by a full account of preindustrial urbanization in the West. Of all features of Western urban history this phase is best known and most adequately described. We have general summaries of the process by Pirenne and others; we have regional studies, as, for example, the works of Rörig on the Hansa and Ganshof on Burgundy and Flanders; we have special studies of particular cities, and comparative analyses of urban developments in various parts of Europe, such as, for example, the work of Lestocquoy or Mlle. Pernoud.[47] The result of these many studies allows us to summarize the urban situation in late medieval and early modern Europe as follows: Urban centers were court cities, cathedral cities, fortress cities, markets, ports, country towns and mere villages. Many, of course, were composites of several types. But despite the emergence of metropolitan centers like Venice, Genoa, Milan, Paris, London, and Amsterdam, or the proud regional centers of the Rhine-Danube corridor, most towns were provincial, if not purely local, in their range of functions and services to the community at large. They were limited (dominated) by the needs and capacities of a rural hinterland and a highly stratified society.[48]

Inhabitants of town and country alike were imprisoned within their physical and mental horizons. To escape meant to transcend rather than transform the environment and, as a consequence, men lacked much practical mastery over nature. Manufactures were largely handicrafts, as much rural as urban, carried on in close relation to husbandry. Animals were often stunted from

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(47) H. Pirenne, Medieval Cities (Princeton, 1925); the forthcoming third volume of the Cambridge Economic History of Europe; F. Rörig, Hanseatische Beiträge zur deutschen Wirtschaftsgeschichte (Breslau, 1928); F. L. Ganshof, Le développement des villes entre la Loire et le Rhin au Moyen Age (Paris, 1943). Among specialized studies on medieval cities, the outstanding are perhaps K. Buecher, Die Bevölkerung von Frankfurt am Main im XIV. und XV. Jahrhundert (Tübingen, 1886); R. Davidsohn, Geschichte von Florenz, 4 vols. (Berlin 1896-1927); also the works of G. Espinas on Douai and Arras, of R. Lopez on Genoa, of G. Luzzatto and F. C. Lane on Venice. Finally see also R. Pernoud, Les villes marchandes aux XIVème et XVème siècles (Paris, 1948), and J. Lestocquoy, Les villes de Flandre et d'Italie sous le gouvernement des patriciens (Paris, 1952).

(48) N. S. B. Gras, "The Rise of the Metropolitan Community," in E. W. Burgess, ed., The Urban Community (Chicago, 1926); Cambridge Economic History, II, 215-18, 263, 325-27, 349-50.

lack of proper feed and care; crop surpluses, important near towns, were small and sometimes non-existent. Mining was likewise rural and rudimentary, confined by technique to exposed and often inaccessible places. Metallurgy remained a skilled but highly esoteric art. Transport was uncertain and, for the most part, limited by cost and capacity to freights of small bulk and high value. Ships moved as the wind freshened; packs were lifted and wheels turned but only as the tensed muscles of men or animals could take the load. Though refined, the channels of communication and commerce were narrow, discontinuous, and rarely strained. The city was becoming a locus for achievement; town and country people led increasingly different lives, but both dwelt in a preindustrial world.

Such a summary treatment hardly does justice to the rich variety of medieval and early modern life. It neglects important currents of thought and action fraught with possibilities for change: the work of astronomers, mathematicians, clockmakers, navigators, artist-engineers, makers of military engines, bankers and merchant venturers, observant travellers. But provided our notion of industrial development is short of cataclysmic undertones, we are not likely to forget the fact that many of the great changes of ensuing centuries were conceived in and nourished by this society in the slow course of evolution. The cities in particular created new kinds of wealth and new modes and styles for achieving it. Nevertheless, after all qualifications are made, it is clear that the distribution and quality of town life in early modern times reflected limits imposed by a preindustrial economy.

(b) The rise of the urban-industrial center: By the early 17th century there had occurred a gradual but profound shift in the focus of economic activity from the Mediterranean world to the maritime fringes of the Atlantic. The history of these changes is well-known and need not detain us at this point. By the late 17th and early 18th centuries, however, the majority of men still engaged in primary occupations. Manufactures, though often organized by itinerant merchants from the cities, were carried on in close relation to the local needs of a growing but fairly evenly distributed population. The location of economic activity remained broadly patterned after geographic features -- the existence of accessible and workable materials in suitable climates. A mounting interest in the material possibilities of the transoceanic world was perhaps the most significant hint at the shape of things to come. The world of 18th century Europe was essentially a loose-knit "system of food economies," centering on a few relatively large mercantile-administrative capitals, with a growing interregional commerce but no marked territorial division of labor.

The quickening pace of agricultural and industrial change in parts of northwestern Europe was accompanied by a singular concentration of productive functions in the semi-rural towns and villages of the day. The shift was most marked in central and northwestern England -- where among other things the restrictive influences of guild and merchant aristocracies had declined. It was also evident in parts of Europe where the formalities of late medieval and early modern economy still obtained. A few of the urbanizing activities were no doubt adopting novel techniques, but most of them show no more than minor mutations on household crafts which had been plied for generations across the countryside. The most significant feature of this early

urban-industrialization in England, the Netherlands, and northern France, was that it permitted experiments in the organization and promotion of business several decades before any widespread application of the power-technology. In many ways the towns were becoming a major outlet for capital accumulated in commercialized agricultural production.

The most forthright statement of the connection between urbanization and industrial development in the "paleotechnic" phase is given by Paul Mantoux in his account of English population movements to the north and west during the second half of the 18th century. For decades people and manufactures had been moving slowly towards the available sources of water power and coal, but "it was the steam engine which finally fixed and consolidated them." The initial migration, however, was not so much due to technology as to newer modes of business organization which spread rapidly in certain localities during the third quarter of the century.

> "Then it was indeed that, wherever it could develop under favorable conditions, the factory system brought about the rise of these mighty centres of population, whose monstrous growth is still going on under our own eyes."

The earliest factories in textile districts using water-wheels were commonly situated outside of the urban center, but

> "they had to be near a town, as serious difficulties of communication and transport made it essential for them to be close to a market, both for buying and selling purposes. Labour was needed, not only for the actual work in the factory, but also for the subsidiary domestic industries without which work in the factory could not be carried on. For there was a period, before the invention and the general use of the power loom, when cotton and wool, which were machine spun, had to be hand woven, and the country weavers were too scattered to meet the requirements of the industry. Thus, even before the time of the steam engine, it became possible for the centers of the factory system to find their geographical position and to develop with a rapidity which foreshadowed their future greatness."[49]

It was in these burgeoning cotton centers, and notably the Manchester district, that the industrial revolution had its most rapid development. Manchester was a Roman site in a natural depression near the junction of the Irwell and the Mersey, into which poured numerous swift flowing streams from the surrounding hills. In medieval times weavers of the Manchester manor produced fine woollen cloth and a famous coarse article called "cottons." In the early 1540's, the preamble to a statute of Henry VIII stated that Manchester

> "hath for a long time been a town well inhabited . . . well set to work in making of cloths, as well as linens as of wollen, whereby the inhabitants of the said town have gotten and come into riches and wealthy

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(49) P. Mantoux, The Industrial Revolution in the Eighteenth Century (London, 1928), pp. 349-73.

> livings, and by reason of great occupying, good order, strict and true dealings of the inhabitants of the said town, many strangers, as well of Ireland, have resorted thither."

But in the 17th century when the cotton industry entered on the scene, Manchester was still only a glorified village. Its size, if not its prosperity, was deceptive. In 1727 Defoe referred to it as "one of the greatest, if not the greatest mere village in England." He attributed to it a population of 50,000, though other contemporary sources indicate that at most its numbers were still less than 10,000. But it was already a local market for an area fifteen to twenty miles around, and a point of assembly and despatch for the waiting ships at Liverpool. In 1757, when Manchester and Salford inhabitants petitioned for relief from the obligation to have their wheat ground at the School Mill, a town census put the population at 20,000 souls. After the completion of the Worsley and Mersey Canals and some effort to improve local roads and streets, the town grew rapidly. In 1773 its population exceeded 27,000.

Thereafter several branches of the cotton manufacture adopted some of the new technique. But as late as 1786 only one factory chimney rose above the town's roofs -- that of Richard Arkwright -- and not before 1790 did Grimshaw combine a Boulton-Watt steam engine and a new spinning mill. In that year Manchester population stood at 50,000, but in the ensuing decade it nearly doubled, reaching 95,000 in the census of 1801. By that date the town had about 50 spinning mills, most of which utilized steam power; two decades later there were 66 cotton, 6 silk, and 6 woollen mills, while the use of rollers in printing together with new bleaching and dyeing processes had extended factory methods even to the later stages of manufacture.

An anomalous feature of this development is the fact that weaving remained a domestic small-shop industry down to the 1820's, though Cartwright's first power loom had been produced as early as 1785. As Leon Marshall has shown, only in the twenties did factory spinning become "unprofitable unless combined with weaving." Manufacturing capitalists were then obliged to install the improved power loom and "to integrate the spinning, weaving, and finishing branches in single establishments employing from 300 to over 1,000 hands." Thenceforth Manchester was no more "a town of little dealers" and after 1824 rationalization of the whole cotton production in southern Lancashire went on apace. By 1845 there were more than 100 integrated factories in Manchester and Salford, and at the half-century mark population reached 367,232. Little more than a quarter of mid-Victorian Mancunians were Manchester-born; nearly three-quarters had been drawn there by the labor market and the very real prospect of higher wages; a fifth were natives of Ireland. At the time of the "Great Exhibition" only London exceeded the size of Manchester in all Victoria's glorious realm.[50]

More significant, from the standpoint of our general theory of urbanization, was the tendency for other concerns to congregate around the cotton

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(50) L. Marshall, "The Emergence of the First Industrial City: Manchester, 1780-1850," in C. F. Ware, ed., Cultural Approach to History, pp. 141-42; G. H. Tupling, "Old Manchester," Jnl. Manchester Geog. Soc., XLV (1935), 5-23.

manufacture. In 1795 John Aiken noted that six foundries were casting wheels and pipes for steam engines and shafts, while tin-platers, braziers, and harness makers were putting out the parts for spinning frames. After the Napoleonic War a stream of engineers located their "works" in Manchester, and the textile machines of Nasmyth, Fairbairn, Whitworth, and Herries carried the industrial revolution throughout the north country In much the same way a whole array of activities developed in the service of the mills and their operatives: railways, building, brewing, chemicals, coal supply, and numerous wholesale trades. Already in 1816 the Manchester Guide reported that a specialized warehouse district had emerged in close proximity to the old Marketplace.[51]

Two other features of the paleotechnic city are of interest here: the role of transportation and the working of business leadership. Manchester had always been important as a local center but the construction of canals in its vicinity made it the virtual nerve center of Lancashire's burgeoning industry. Manchester merchants controlled the flow of materials from Liverpool docks, commanded the marketing of semi-finished and finished goods, and slaked the almost insatiable thirst for risk capital. The Bank of England felt obliged to come to town in the late twenties and several joint-stock banks got underway. All this occurred before the completion of the first railroad from Liverpool to Manchester in 1830; four other lines served the town by 1845. The railway of 1830 was sponsored by the Chamber of Commerce and other business groups, and it was brought to Manchester to serve the city's needs. The city, however, was already "an industrial metropolis" two decades or more before the railroad when its population passed the 100,000 mark. As Manchester grew, the industrial revolution grew with it. If the city benefited from its improved transport service, transportation benefited no less from the city. Manchester proved that the railroad was here to stay.

Long before Mancunian merchants helped revolutionize communications by their investment in the "railway experiment," they had promoted the industrial revolution itself. From the mid-18th century cotton merchants and manufacturers had fostered the development of new tools and machinery. They formed a "Committee for the Protection of Trade" which offered attractive rewards for practical inventions. The "Manchester Literary and Philosophical Society" debated the application of science to the industrial arts: in its publications appeared some of the early researches of Dalton and other pioneers of textile chemistry. Merchants, who had previously provided the initiative and capital to link up the dispersed stages of cotton production, made themselves over into "management" by adopting new techniques and "integrating" them with labor and materials in the first industrial "production lines." Fortunes were made (and sometimes lost) by these industrial entrepreneurs as they pioneered a new style of business leadership. Though he eventually lost his hard-fought patent suit, Richard Arkwright became an industrial millionaire.

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(51) L Marshall, loc. cit., pp. 143-44; A. E. Taylor, "Concentration and Specialization in the Lancashire Cotton Industry, 1825-1850," Econ. Hist. Rev., I (1949); R. Smith, "Manchester as a Centre for the Manufacture and Merchanting of Cotton Goods, 1820-30," Univ. of Birmingham Hist. Jnl., IV (1953), 47-65.

These same business leaders gave a new meaning to the word "freedom"; a meaning which came to serve as the rationale for a new socio-economic order. By 1780, though many medieval residues survived in Manchester, the gentry and clergy had come to share authority with merchants and representatives of the liberal professions. Among the most numerous residents at this time were "tailors, woolcombers, worsted weavers, shoemakers, dyers, joiners, silk weavers, and hatters" but they did not share in the government of the community they had built. Below them on the social scale came a miscellaneous assortment of "porters, unskilled laborers, and a growing number of cotton weavers and shop keepers." Three years later James Ogden wrote in his Description of Manchester

> ". . . perhaps nothing has more contributed to the improvement in trade here, than the free admission of workmen in every branch, whereby trade has been kept open to strangers of every description, who contribute to its improvement by their ingenuity."[52]

By the early 19th century Manchester society was open for achievement. The early industrialists had mostly risen from the ranks of skilled craftsmen and did not make the fine distinctions of their predecessors in the urban guilds concerning such extraneous matters as place of residence, years of apprenticeship, and family background. These were not qualifications for factories: men were to be judged on performance, not parentage. Masters wanted "hands" when there were jobs to fill and, by the same token, wanted to be rid of them when conditions no longer warranted their employment. But it was also good to have hands in the vicinity, if conditions changed again. Hence the factoryman strove to create a "flexible" labor market in Manchester, to establish "freedom of contract" between individual masters and servants, to repeal Tudor restrictions on mobility. He cooperated willingly with enterprising Boards of Guardians who, under Chadwick's Commission, desired to supply Manchester with the additional labor of the able-bodied poor. Understandably, such a master disapproved of spinners' combinations as interfering with the individual's right to sell his labor to the highest bidder; he deplored the efforts of organized workingmen to "dictate" terms and conditions of employment. We do not have to accept the many ex parte statements and unsworn evidences given before Sadler's Committee in 1832 to appreciate that factory life was a hard, strange and systematic regime for Manchester's semi-rural proletariat. The adaptation of workers to factory routine and discipline has always been a painful experience. If it was hard for Mancunians in the twenties, it was no less hard for the textile workers in Rutherford County, N.C., in the eighties. Even tomorrow emancipation from "feudalism" and the prospect of higher real-wages may prove a bitter pill for the villagers of Africa and India as they leap to the insistent time of the factory bell.

But the growth of urban-industrial society raised many issues besides the relations of masters to men and of men to their work. There were the old but intensified problems of cities and city life. Grave new questions of public health, housing, utilities, services, boundaries, authorities, morals, law and

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(52) Ibid., pp. 145-6; J. Ogden, Description of Manchester (Manchester, 1783), pp. 43-4.

order, had to be "solved" with institutions, techniques, and taxes inherited from a manorial village. As Marshall put it: "To control the social forces impacted in Manchester" the industrialists "had to wrest existing institutions from entrenched interests, to create and extend new institutions, and to fight off compromise with the newer elements in the community."[53]

Not before 1790, when population exceeded 50,000, did Manchester begin to throw off its manorial and parish offices -- and then largely by default. Chaos and congestion in the streets forced the creation of a "police commission" by Act of Parliament. This body, composed of "thirty-pound ratepayers," was charged with street improvement, supervision of lighting, night-watching, cleansing of streets, and the regulation of traffic. As businessmen gradually brought their economic influence to bear on the commission, it tended to displace the medieval Court Leet as the town government. It exposed the ineffectiveness of vestrymen and churchwardens when dealing with problems created by economic development. Through constant criticism of finances and violent interruption of vestry meetings, the industrialists forced some public accounting and the concession of many powers to the Police Commission. In 1807 the Commission built Manchester's first gas works for street lighting, and ten years later, the shopkeepers requested the sale of gas to private consumers. The Commission devoted the profits from this "socialistic" venture towards their "improvement" program, but the shopkeepers promptly demanded -- in the name of "the people" -- a lowering of rates. Frustrated in this, the "tradesmen" sought to establish a competitive supply, but nevertheless blocked the same proposal some years after when many of their class had been admitted to seats on the Commission. For many years, however, Manchester residents were to witness the spectacle of great capitalists arguing against "consumer sovereignty" at the local level in the name of "public policy" and the "social-service state," while Tory churchwardens allied with shopkeepers and trade unionists to protest this exercise of "despotic power."

Such conflicts ultimately brought the Police Commission to deadlock. Only as more shopkeepers qualified for membership and the "cotton aristocrats" moved to the suburbs was the body reconstituted to increase the influence of middling property and the ameliorating power. Finally in 1838, Cobden and his associates secured a charter of incorporation from a reluctant Privy Council over militant opposition from Tories and "common people." In 1844 when the Corporation celebrated the triumph of industrial capitalism by burying out the ancient manorial rights, it ominously opened the door for "creeping socialism" by purchasing the Manchester and Salford Water Company.

Reform in Manchester assumed a pattern. No sooner had the Statistical Society -- founded by bankers and manufacturers in 1834 -- completed one of its notable surveys of health, education, or working conditions than the Corporation would make a gesture towards public improvement. It even sought to fill a great "cultural void" left by religious philanthropy and private charity

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(53) Ibid., p. 149.

when, in 1852, a Public Library took over books from the old Mechanics' Institute. Yet amelioration was not a simple, irresistible, surge. This was also the Manchester of Engels and Mary Burns, compared with which Elberfeld-Barmen seemed like a pleasant country town. Epidemic, fire, corruption, crime, vice, all took their toll of life and property before enumerators from the Statistical Society could reveal the enormous "social costs" of economic progress. In 1839 only the restraining influence of General Napier's loaded cannons prevented serious rioting among the outraged populace. But this "first industrial city," whose dynamic growth had brought about such conditions, was also to generate wealth and social ingenuity with which to fight all but the most chronic morbities, which stemmed perhaps not so much from "the system" as from the human flesh itself.

To some observers Manchester's greatest triumphs were reserved for the national stage. After 1820, when her merchants joined those of Liverpool and London in the famous petition, the ear of government bent slowly to the siren call of "Free Trade." The Chamber of Commerce was formed in 1821 to review national policy from the standpoint of local industry. In the same year, five manufacturers founded the Manchester Guardian to advocate the town's point of view. To this day the paper remains the most authentic and articulate voice of English liberalism. After the reform of 1832, the town elected four members of parliament, and, when the Anti-Corn Law League sent out pamphlets and agitators into every corner of the land, Manchester called the tune of a nationwide political debate. In 1853 a writer in Littell's Living Age proclaimed:

> "The whole kingdom has seen that district which it contemned as a region of grinding capitalists, without a thought save of cotton and stunted serfs . . . suddenly dart into magnificent political energy and power; found a new economic and social system; and by the peculiar clearheadedness of the views, and still more peculiar working energy of its people, triumphantly direct the policy of the land."[54]

We have dwelt long in Manchester and followed its story from Defoe's "the greatest mere village" to Littell's final eulogy, but as Mantoux affirmed "(d)ue allowance being made for differences in size and importance, the history of Manchester is typical of what took place in most of the towns around it." He instanced Oldham, Bolton, Rochdale, Bury, Blackburn, Preston, Wigan, Stockport, Ashton, Stalybridge: "everywhere on this poor soil the same fruitful seeds gave a harvest of cities."[55]

By the first decade of the 19th century Britain was already developing a hierarchy of industrial-commercial-transport centers. At 864,845 the population of London far exceeded any other city: Manchester-Salford, Birmingham, Bristol, and Leeds ranged from only 50,000 to 100,000. Below

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(54) Littell's Living Age, XXVI (1853), 241, cited by L. Marshall, loc. cit., p. 160.

(55) P. Mantoux, op. cit., pp. 367-68.

these came an assortment of preindustrial and industrial towns, seaports, and resorts, including Greater Plymouth, Norwich, Portsmouth, Sheffield, Rochdale, Nottingham, Newcastle-on-Tyne, and Bath, in that order. In Scotland at this time Edinburgh still outdistanced Glasgow in the 50,-100,000 category, but the latter was already "enflamed" in emulation of Manchester. Paisley, Aberdeen, and Dundee had also grown beyond 25,000 inhabitants.

Yet it must not be thought that all Britain was developing into one great urban colossus. The woollen industry, for example, had also been affected by technical changes, but Yorkshire towns experienced a slower rate of growth and a smaller net increase in population than the Lancashire cotton towns. Cotton, for all practical purposes, was a "new" industry using a colonial raw material; wool, on the other hand, had existed in some form "time out of mind" wherever sheep would graze. Though the older woollen towns of East Anglia and the southwest were no longer in a position to compete with Yorkshire -- even with benefit of the new technology -- they nevertheless did restrain the rate of concentration and growth in the north.

In the early 18th century Leeds had been a larger town than Manchester but, by 1775, just before the introduction of the jenny, its 17,000 parishioners represented little more than half the size of Manchester. The growing importance of water power in the first half of the 18th century had actually brought about some dispersion of the industry from Leeds, but Manchester, of course, had experienced a similar exodus for much the same reason. Only in the middle nineties did "integrated" woollen factories appear in Leeds and the centralizing tendency become marked. In 1801, when the population of Leeds parish reached 53,000, more than 30 per cent of the people lived outside the town limits and plied their crafts in households or small shops. In the adjacent parish of Halifax, the influence of factory and machine was even more retarded. Being more widely dispersed than cotton, the woollen industry seems to have grown more slowly at the local level. In 1806 a Select Committee on the Woollen Manufacture reported the old-style technique dominant in the Halifax district, with characteristically small holdings, small-scale output, and domestic organization. Between 1760 and 1801 Halifax, despite its greater area, increased its numbers by only 26 per cent compared with Leeds growth of 70 per cent. Thus, if the woollen industry as a whole expanded in the last quarter of the 18th century, it was Leeds rather than Halifax or Bradford which produced the major change. The next great advance in the area came after 1830 when in ten years Leeds population increased 47.2 per cent, exceeding 100,000 by 1841. In that year Bradford entered the 25-50,000 category and, twenty years after, also passed the 100,000 mark. But in 1806 when the Select Committee had reported on the woollen districts, the outward facade of Halifax and Bradford had changed little since the early 18th century. In Halifax, for example, the small stone cottages still clustered round the old gothic church in the center of town and the weavers gathered from far around as their fathers had done for generations. Across the county boundary in Manchester there was already a sprawling town of dark brick where thirty years before most houses had been built of clay and wood. Manchester's factories were built several storeys high and soon each floor would be specialized in one or other stages of the cotton manufacture.

Mantoux reports that the iron towns were different again. If they grew less rapidly than cotton towns, they nevertheless grew faster than the woollen

ones. There are several closely connected reasons for this delay which are implicit in Ashton's account of early technical changes in iron production. Iron was first a crude ore before it was a malleable material, and first a raw material before it was fashioned into a finished product. Towns like Birmingham and Sheffield were largely concerned with the later stages of manufacture; they were clusters of small craft specialties where novelty was always suspect and traditional methods died hard. Iron, like wool, was an ancient trade and its sources were widely dispersed throughout the forests and valleys of the Midlands. Most of the revolutionary changes in technique occurred in the early stages of production outside of the finishing centers which remained fixed in their craft traditions for another generation or more. The important developments took place in centers like Coalbrookdale, Carron, Bersham, and Bradley, where men like Darby, Wilkinson, and Crawshay had their large proprietary concerns. Thus, as Conrad Gill suggests, Birmingham lacked large capitalists and ready credit during most of the 18th century, nor did its conservative craftsmen suffer much from turnpike and canal fever. At the time of its founding, even Boulton's great Soho works was some distance out of town. Nevertheless, once the raw material came along the canals in greater quantity -- from places as far removed as Wolverhampton, Worcester, Warwick, and Tamworth -- the metal workers were obliged to change the scale, if not the method, of their operations. The increase in scale later brought about its own techno-organizational response. It is clear that, if the use of coke in blast furnaces, puddling, and other novel processes did not at once transform Birmingham hardware or Sheffield cutlery, the metal trades grew larger, more profitable, and more specialized, contributing thereby to the size and variety of early industrial towns.[56]

In 1750 Manchester had been only two-thirds the size of Birmingham, but by 1801 Manchester had quadrupled its population while Birmingham had barely doubled. There were 73,000 inhabitants of Birmingham in 1801 in an area which extended over little more than a square mile between three canals. Sheffield grew even more slowly than Birmingham. In 1760 its population reached 20,000 but in 1801 the tally had only been increased by 25,000. The nature of its steel and cutlery products, together with its somewhat peripheral position vis à vis the first main thrust of the industrial belt, combined to curb its growth in the early industrial period. Perhaps Sheffield never did overcome these particular handicaps completely, whereas some of Birmingham's early liabilities were actually turned to account during the next century. The latter's population had soared to 242,000 by 1851, but not before another decade had passed did Sheffield reach 100,000.

Asa Briggs has suggested that the rich diversity of local skills furnished Birmingham (and the whole Black Country) with a large but comparatively steady labor market even in times of depression, a market which proved adaptable and flexible in periods of rapid technical change or shifts in fashion. Moreover, the very close economic and social relationships between masters and men helped that community avoid the worst of those debilitating conflicts which marked industrial development elsewhere: viz. Briggs' suggestive

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(56) Ibid. Also, C. Gill and A. Briggs, A History of Birmingham (2 vols., Oxford, 1952), I, 87-90, 103-06.

contrast with conditions in the great French textile center of Lyons, 1825-48.[57] This unusual feature of the Birmingham community may also have lessened the need for, and hence the cost of, local social and administrative reforms such as occurred in Liverpool and Manchester quite early in their paleotechnic history. Certainly Birmingham's great flexibility and unflagging enterprise gave her leadership in the neotechnology of the late 19th century and a dominant voice in national economic policies of the 20th.

In 1832 the Manchester Guardian argued, by way of apology for the housing conditions of the industrial working class, "(t)he manufacturing system as it exists in Great Britain, and the inconceivably immense towns under it are without previous parallel in the history of the world." A decade later William Cooke Taylor wrote, more affirmatively, in his Natural History of Society, that the industrial town revealed "a system of social life constructed on a wholly new principle, a principle yet vague and indefinite but developing itself by its own spontaneous force, and daily producing effects which no human foresight had anticipated." Robert Vaughan, author of the Age of Great Cities, described the city trend as yet a higher grade in the great school of life: "(s)uch, indeed, is often the astuteness acquired in the exercise of this greatest of free schools that the smith of Sheffield, or the weaver of Manchester, would frequently prove, on any common ground, more than a match for a college graduate."[58]

Thus the paleotechnic cities were hailed by these contemporaries as "British," unprecedented, dynamic, and elevating. And there was something, perhaps, in all of the claims except the first. During the first half of the 19th century, urban-industrial concentrations developed in a number of areas outside the British Isles: in N.E. France, the Low Countries, and along the North American seaboard of the United States. Everywhere urban concentration was symptomatic of economic change.

The case of France is specially interesting since even today that country is predominantly rural and her cities are small. A full explanation would, however, involve all of modern French economic history, so we must be content with examining features peculiar to French development. Though large manufactories had appeared at Abbeville, Elbeuf, Sedan, Beauvais, and Sèvres before 1700, the special nature of their high-value, luxury output precluded emulation and competition -- the vital ingredients of growth. Furthermore, despite the French contributions to technique and organization in the 18th century, most of the historic cities were not industrialized after the English model: they remained isolated administrative-commercial centers of narrowly regional economies. Few cities, apart from Lyon, the seaports Marseille and Bordeaux, and the capital acquired a national significance. In some ways the economy was overcentralized in Paris, but in others it remained paralytically local. The enduring strength of craft and mercantile guilds in many

(57) A. Briggs, A History of Birmingham, II, Ch. I; A. Briggs, "Social Structure and Politics in Birmingham and Lyon, 1825-1848," Brit. Jnl. of Soc., I (1950), 67-80.

(58) Cited by R. E. Turner, "The Industrial City: Center of Cultural Change," in C. F. Ware, Cultural Approach to History, pp. 228-29.

places acted as a damper on manufacturing districts, while the periodic adventures of an "absolute" government into the field of financial and economic reform proved wholly ineffectual.

Over the first half of the 18th century French population increased only slightly: the rate for the whole century was less than 20 per cent. By 1800 Paris -- to include only the city proper -- reached 547,000; while the next largest centers, Lyon and Marseille, had about 110,000 each. Toulouse at this time had barely 50,000 inhabitants. Between 1800 and 1850 French national population rose about 28 per cent and the approximate density of population per square mile increased in the same ratio. But over the half century, Paris increased its size about 90 per cent to reach 1,053,000 in 1851. Toulouse, the great regional center in S.W. France, rose about 85 per cent to 93,000; the city of Lyon rose about 75 per cent to 156,000; Marseille about 40 per cent to 195,000. Small wonder that many Frenchmen became alarmed at the growth of these "central" cities and, in view of their lower fertility and higher mortality rates, warned against the social consequences of rural depopulation.

More disturbing to some conservative critics in France was the vast new industrial conurbation in historic Flanders, Lille-Roubaix-Tourcoing, which by 1851 had acquired a population of 251,000. Coal, superior transportation, business leadership, and a skilled labor supply from Flanders and Belgium, had all contributed to this dynamic growth in the second quarter of the century. The first steam spinning mill in France was installed at Lille as late as 1801. The congestion of population in the old city reached an appalling level by the mid-century. In the Lyon-St. Etienne group something very similar had happened; the two centers tended to grow together with a combined population of 321,000. In the Departement du Nord a cluster of paleotechnic towns had grown upon the extensive coalfield which had been worked for more than a century before 1851. The combined industrial population in the area reached 194,000, yet only two of the centers had populations exceeding 10,000: historic Valenciennes with 23,263, and Douai with 20,523. Others in the district, Lens with 9,796, Denain with 8,691, Béthune 7,692, Anzin 5,000, were little more than paleotechnic villages.

We may, perhaps, differentiate two types of town in France during the early industrial period and the distinction is far from academic since large areas of the country have never developed far beyond that stage of development. (1) A series of older administrative-commercial centers -- or more properly regional hierarchies of such centers -- whose inhabitants were chiefly occupied in servicing extensive rural hinterlands and who, as a consequence, maintained a very close contact with the agricultural population. The socio-economic atmosphere in these places was not exactly "preindustrial," for many 18th century landmarks had disappeared in the revolution, yet the wide range of daily rural-urban contacts were essentially of the "market" or "trade" variety. Sometimes manufactures in the vicinity retained a part-time or seasonal character; they often frustrated the process of urban-industrial concentration. Though there were relations with the changing world outside, the social and psychological isolation of such towns from Paris, on the one hand, and the industrial centers, on the other, has left a deep rift in modern French society.

Pierre George has subdivided such towns into those which have non-specialized market bases and those which have specialized bases.[59] The former, such as Luçon and even Angers, were (and still are) closely integrated with an older "peasant" agrarian social structure, while the latter, such as Cavaillon and Beziers, developed a kind of provincial "country town" sophistication on the fringe of an industrial economy. They were less involved with the countryside, provided more specialized services of their own; their inhabitants sometimes engaged in playing the market, and especially enriched themselves through the growth of tourisme (either clerical or resort business). According to George, this latter sub-type was especially vulnerable to recurrent crises in the national and world economies.

(2) The second major type of town which developed in early 19th century France resembled the English model since it was dominated by the changing circumstances of industrial life. There were, for example, many local manufacturing centers, like Albi, with deep roots in the preindustrial past, whose growth was cut off either by natural isolation or by their failure to acquire adequate connections with the world outside. The railway strengthened the dominance of Toulouse over the whole southwestern region: it became a supply center for the surrounding country "and for those small towns which had hitherto been independent centres." Toulouse likewise took over most of the wholesale business in the southwest while its engineering and consumer goods activities grew at the expense of places like Albi. The development of hydro-electric power in the nearby Pyrenees seems, if anything, to be reinforcing the dominance of Toulouse in what is after all an area with limited industrial potential.[60] At the other extreme were a few burgeoning conurbations, like those around Lyon and Lille, which proved to be the dynamic centers of French industrial growth. In between the small centers like Albi and the industrial conurbations were a few "diversified" centers based, like St. Etienne, on a material source or, like Marseille and Bordeaux, on a great port. In a class of its own was Paris, hub of a radiate transportation network and an agglomeration of almost every economic activity except heavy industry. Paris was likewise the center of the country's hectic political and social development. Between Paris and the small country towns and local manufacturing centers stood only a relatively few specialized coal, textile, and port cities, as though the dynamism of the metropolis tended to draw off much of the nation's vitality and wealth to itself.

Professor Hancock once dramatized the development of economic policy in 19th century Britain as an inter-urban struggle "between free-trade Manchester and protectionist Birmingham -- or better still a three-cornered struggle, with the old individualist, cosmopolitan city of London joining forces with Manchester to keep Birmingham in check."[61] Nothing comparable to this inter-urban competition became significant in French economic growth; there it was rather province against province and the metropolis against them all.

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(59) P. George, La Ville (Paris, 1952).

(60) R. E. Dicksinson, The West-European City (London, 1950), passim.

(61) Survey of British Commonwealth Affairs (London, 1940), II, 92.

Early American urbanization had much in common with that of Britain and France during the early industrial periods. The profound elements of continuity with Europe have, in fact, often been underestimated, but the essentially colonial setting of early towns in English-America affected both their economic role and social structure. They were, moreover, new towns in a new country and differed considerably from their colonial counterparts in the Middle and Far East. The colonial centers in North America have been described by Carl Bridenbaugh as "cities in the wilderness."[62]

As in Europe, exigencies of military and religious life often led to the siting of early settlements in North and South America, but the broad effects of commerce and communications had more to do with subsequent growth. Our concern is, therefore, not so much with "origins" as the cause and character of expansion. These appear to be largely matters of resources and policy; for once a location is selected to exploit some strategic position, it tends to become a nucleus for related and associated activities which vary, of course, with the particular hinterland. Towns grow only as they generate opportunity for the alert and enterprising to promote new business around a basic "carrier" core.

The "carrier" core of colonial towns was chiefly a commerce in food and raw materials, diversified somewhat by imports of English manufactures and the output of local craftsmen and mechanics. The colonial economy was a dependent economy and, like that of Australia and New Zealand more recently, it depended on the European homeland for population, capital, customers, and much of its enterprise. During the 18th century a small domestic market developed and inter-colonial trade -- such as that between the northern colonies and the West Indies in fish, grain, lumber, meat, molasses, fruit, and coin -- became important. Some of the population in the middle colonies were even "sliding into the manufactures proper to the mother country," manufactures in textiles and iron, but there was little real "industry" comparable to that in European centers. From the fringe of settlement in the Ohio Valley to the coast, the Anglo-American territories were sparsely-peopled regions of primary, chiefly agricultural, production. There was a lively commerce, mostly by sea and river, financed and fostered by merchant capitalists in England or their agents and "native" competitors in seaboard towns and villages. But beyond the tidewater there were few settlements and little trade of consequence. As late as 1780 only Philadelphia among colonial towns had more than 20,000 inhabitants and only four other places, New York, Boston, Charleston and Baltimore, had more than 8,000.

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(62) C. Bridenbaugh, Cities in the Wilderness (N.Y., 1938), Ch. 3.

(63) A. B. Maclear, Early New England Towns (N.Y., 1908), p. 13. "In a new country the rapid growth of cities is both natural and necessary for no efficient industrial organization of a new settlement is possible without centers to carry on the necessary work of assembling and distributing goods." Philadelphia City Planning Comm'n, "Economic Base Study," Planning Study No. 2 (1949), p. 6. In Spanish-America cities were first sited more with reference to military conquest and administration; see B. Holmes, A History of the Americas (N.Y., 1952), passim.

Between 1790 and 1810 the number of American cities with more than 8,000 inhabitants increased from six to eleven. By the latter year New York had risen to first place with 96,400 and Philadelphia was second with 91,900. Baltimore stood at 35,600; Boston at 33,300; Charleston had reached 24,700; and New Orleans 17,200. Next largest were Salem with 12,600 and Providence with 10,000. The percentage of total population in cities 2,500 or more had risen from 5.1 to 7.3 over the first two full decades of independence, but the proportion in cities 8,000 plus rose only .7 per cent.

The decade 1810-20 showed a relative decline of cities in nearly all states due to the interruption of commerce and growth of agriculture. As late as 1820 only six towns had populations over 20,000, and one of these, Charleston, had hardly grown in the intercensal decade. New York and Philadelphia, however, both exceeded 100,000; and Baltimore passed 62,000. Yet none of these leading centers could properly be called a paleotechnic city in the sense of Manchester, Birmingham, or Lyon. The expansion of all, with the possible exception of Philadelphia, was essentially a commercial-servicing growth due to the swelling of trade as more resources from the continental interior became available.[64] New York had been especially successful in attracting trade from the backcountry and by 1815 enjoyed a foreign commerce twice that of her rivals Boston and Philadelphia. Robert Albion has suggested that New York had more than mere positional advantages in the struggle. Her business leaders had established a very successful auction system for disposing of imports; there were regular and reliable transocean packets; and a growing coastwise trade, especially with parts of the South. The completion of the Erie Canal in the middle 'twenties clinched New York's supremacy and set off a nationwide mania for internal improvements.[65]

Baltimore had grown nearly 80 per cent in the decade of the second war with England, Boston by little more than 30 per cent. To be sure, population is no absolute index of development, but in this case it registers deep-seated strands of change. Baltimore merchants had demonstrated singular enterprise. They gained control over the great tobacco and grain trade of Virginia, Maryland, and much of central Pennsylvania; they encroached upon the greener preserve of Philadelphia and outdistanced all rivals in the rising overland trade from Ohio. They built and serviced a proud "clipper" fleet; in 1828 they commenced building the Baltimore and Ohio Railroad. Boston, on the other hand, was losing ground as a viable commercial center in this "clash of urban imperialisms." Its fleet was unmatched and its growth considerable, yet its geographic position in relation to the main thrust of internal development and the paucity of export staples in its own back country combined to threaten its life as the great entrepot of the north. After the War of 1812 her merchants set about cornering the entire trade of the hinterland and their

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(64) Thus Philadelphia already had a diversified industrial base: textiles, hats, grain and saw mills, hosiery, paper, printing, sugar, iron foundries, toolmaking, carpets, carriage works, stove-making, and shipbuilding. The city was also a center of rationalism and scientific enquiry.

(65) R. G. Albion, The Rise of the Port of New York, 1815-1860 (N.Y., 1939).

success is measured in the relative decline of all her local competitors. G. R. Taylor has suggested that Boston merchants were "forced to create business"; this they did by financing an industrial revolution in Massachusetts. If Boston did not itself become another Manchester, nevertheless its leaders did as much for New England as the Free-Traders did for the Old.[66]

Small mills and neighborhood manufactories do not constitute an industrial revolution. These there were -- as every schoolboy once knew -- in Philadelphia, Beverly, Pawtucket, Patterson, and elsewhere, long before 1800. The spinning mills which sprang up in the valleys of southern New England, but which remained dependent over many decades on nearby farm families for their weaving, did not at once grow into urban-industrial concentrations. Nevertheless, they were an invaluable, almost essential, preparation for the main event -- the introduction of the factory system on a scale. These pre-industrial developments helped "urbanize" a labor force; they fostered a contriving inventiveness with machines; they accumulated a great potential of "external economies" which were later turned to account when the time came for expansion.

The impetus toward the "integrated" factory, however, came not from the semi-rural manufactures but from the embattled commercial metropolis itself. It was symbolized in Lowell's Boston Manufacturing Company of 1813. "None but wealthy men," writes George R. Taylor in his Transportation Revolution, "could have financed such a venture and probably none but merchants used to the huge risks attendant upon foreign trade during the Napoleonic Wars would have had the initiative or courage necessary for a project involving such drastic innovations in the techniques of production and business arrangement." $600,000 of mercantile capital went into the so-called "Waltham Plan" before 1820 and this was used to finance the improved power loom and to integrate the several specialized processes of cotton cloth manufacture under unified managements in single plants.

The Boston Associates established a Lowell factory in 1822, and in the same year Boston authorities instituted gas-lighting. The following year the Associates opened another factory at Chicopee, and the authorities established a municipal sewage system in the metropolis. Soon a cluster of paleotechnic textile, leather, and metal towns -- including Nashua, Waltham, Lynn, New Bedford, Worcester, and Fall River -- sprang up around the bright Boston sun. The impulses from the north moved southward to the somnolent "colonial" centers at Providence, New London, Hartford, and New Haven. "In 1840," wrote Percy Bidwell, "it would have been difficult to find 50 out of 479 townships in Southern New England which did not have at least one manufacturing village clustered around a cotton or a woolen mill, an iron furnace, a chair factory or a carriage shop, or some other representative of the hundred miscellaneous branches of manufacturing which had grown up in haphazard fashion in every part of these three states."

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(66) G. R. Taylor, The Transportation Revolution, 1815-1860 (N.Y., 1951), Ch. 1; Vera Schlakman, "Economic History of a Factory Town," Smith College Studies in History, 20 (Northampton, Mass., 1936); J. W. Livingood, The Philadelphia-Baltimore Trade Rivalry, 1780-1860 (Harrisburg, 1947).

Larger woollen investments followed closely on cotton. Huge distilleries, glass factories, tanneries, and certain stages of carpet manufacture adopted more "integrated" methods of production and management. Capital for many of these ventures was drawn mainly from local merchants; even farmers. Not all metropolitan centers, however, were under the same pressure as Boston to promote the rise of industry. Indeed, the great difficulty for many manufacturers was the fact that capital was being drawn off into shipping, internal improvements, or agriculture. The manufacturing side of the early industrial revolution was financed in large part out of profits. It is understandable that little was available for common housing, sanitation, and the civilizing amenities of urban life.

The shortage of capital in the United States may well have been an additional factor retarding the movement of iron manufactures into the towns. But there were also many technical problems to be overcome before the urban location would acquire decisive advantages over the country. By the late 'forties, however, improvements in transportation had led to some concentration of furnaces and rolling mills in eastern Pennsylvania and in the Morris county area of western Jersey. In the great river valleys of western Pennsylvania, miners were already digging below the surface outcrops and Connellsville coke was on its way to driving out charcoal even in the smaller furnaces and forges. Pittsburgh, which already had four decades of manufacturing experience in glass, iron castings, nails, shoes, and textiles, was on the threshold of an unprecedented development.

During the four ante-bellum decades, while Englishmen thought that they were being rather unique, urban population in the United States increased by nearly 800 per cent. National population in the same period rose only 226 per cent. Between 1840 and 1850, under the impact of railroads, urban population nearly doubled (92.1 per cent). By 1860 more than 100 cities exceeded 10,000 inhabitants, fifteen topped 50,000, eight exceeded 100,000 and New York City passed 1,000,000. In the midst of this urban transformation George Tucker wrote his Progress of the United States in Population and Wealth in Fifty Years (1843) and commented,

> "The proportion between the rural and town population of a country is an important fact in its interior economy and condition. It determines, in a great degree, its capacity for manufactures, the extent of its commerce, and the amount of its wealth. . . . Whatever may be the good or evil tendencies of populous cities, they are the result to which all countries that are at once fertile, free and intelligent inevitably tend."

It would be misleading to suggest that this explosion of American cities was due entirely to the growth of urban manufactures. It was much more the outcome of a continental development carried out with railroads: colonialism on a continental scale. The following table of the fifteen "great cities" in 1860 reveals the relative insignificance of manufacturing in all but a few cases:

Leading Cities in 1860 in Order of Percentage of Population Occupied in Manufactures[67]

Name of City	Total Population	Percentage in Manufactures
Newark	71,941	26.2
Providence	50,666	20.0
Cincinnati	161,044	18.3
Philadelphia	565,529	17.5
Boston	177,840	10.8
Louisville	68,033	9.8
New York	1,080,330	9.5
Albany	62,367	9.3
Baltimore	212,418	8.0
Buffalo	81,129	6.9
St. Louis	160,773	5.8
Chicago	109,260	4.9
Washington, D.C.	61,122	3.9
New Orleans	168,675	3.0
San Francisco	56,802	2.6

Nevertheless, there were already several sizeable urban-industrial concentrations, mainly in the northeastern manufacturing areas, with populations ranging from 19,000 to 50,000, such as Lowell with 36 per cent in manufactures and Lynn with 45 per cent. These were the true forerunners of American "Coketowns." In 1820 the total U.S. capital invested in manufacturing amounted to only $50,000,000; by 1840 the figure had reached $250,000,000; but only in 1860 did it reach one billion dollars; and of the total value of manufactured products in that year, flour and meal accounted for 25 per cent.

Between 1860 and 1900 the most notable fields for new investment were railways, iron and steel, coal, meat packing, and machinery. By 1900 the value of iron and steel products alone exceeded $800,000,000 and the amount of coal mined rose to 212,000,000 tons compared with only 6,000,000 tons in 1860. By the close of the century the developing areas of neotechnology accelerated the over-all rate of growth by providing new outlets for capital -- electrical equipment and utilities, light engineering, petroleum, and urban construction. Then followed automobiles, oil, gas, rubber, synthetic chemicals, aircraft, radio, and, more recently, electronics and atomics, proffering rich fields for private and public investment. In many ways the fortunes of Pittsburgh symbolized the rise and subsequent transformation of the paleotechnic composites.[68] Pittsburgh grew very rapidly after the Civil War as the integration point for Connellsville coke and Superior ores. In one decade, 1880-90, the annual growth

(67) Adapted from 8th U.S. Census, Mortality and Miscellaneous Statistics, xviii.

(68) C. E. Reiser, Pittsburgh's Commercial Development, 1800-50 (Harrisburg, 1951); G. E. McLaughlin and R. J. Watkins, "Problems of Industrial Growth in a Mature Economy," Amer. Econ. Rev., XXIX (1939 Supplement).

of industry in the area, according to Professor McLaughlin, was ten per cent, or twice the rate of growth for the national economy as a whole. During the 'nineties the spread of open-hearth techniques helped Pittsburgh hold its own with the rest of the country, but in the first decades of the 20th century its rate of growth slackened. Its fortunes were briefly revived in World War I, but tended to lapse again thereafter. Its problems were multiplied, like those of the New England cities, by the rise of competitive centers in newly developed parts of the interior. By the late thirties Pittsburgh was thought to be an "over-mature," if not "obsolete" industrial city.

Before we consider these neotechnical influences in detail, however, one feature of the American experience deserves special attention, namely, the role of cities in westward expansion. The exclusively agrarian character attributed to this movement by American historians has tended to obscure the vital contribution of the cities.[69] In every new country the growth of central places is essential since no efficient economic organization of settlement and development is possible without communities which carry on the important work of assembling and distributing goods. From the late 18th century, therefore, certain places in the interior -- the "valley centers" and "lake centers" -- served as entrepôts for trade and commerce. The development of mineral and agricultural resources, for example, always required places which specialized in handling and shipping raw materials and wholesale goods. Migrants to the Mississippi Valley sited and developed their urban real-estate even before farmers in the area had brought in their first commercial crops. In 1840 only New Orleans exceeded 100,000 in population and, strictly speaking, this was a colonial-type city like Old Boston or Baltimore rather than a city of the interior. By 1860 Cincinnati had passed 150,000, and Chicago 100,000; Louisville and Buffalo were both well past the 50,000 mark: by the 'seventies the "middle West" had seven cities with populations exceeding 100,000. Thus the five "Lake Cities," Buffalo, Cleveland, Detroit, Chicago, and Milwaukee, had a combined population in 1870 which was sixteen times their combined population in 1840, while their states had increased their populations only three times over during the same period.[70]

It is clear from the researches of Bayrd Still, Bessie Pierce, and others that the great economic and urban growth of the interior "involved substituting the encouragement of manufacturing for an earlier emphasis on trade." By the 'fifties the more far-sighted leaders of midwestern communities had realized that potential growth was limited so long as it was based exclusively on commerce. The editor of the Cleveland Leader declared:

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(69) C. M. Gates, "The Role of Cities in the Westward Movement," Mississippi Valley Hist. Rev., XXXVIII (1950); F. P. Weisenburger, "Urbanism in the Middle West: Town and Village in the Pioneer Period," Indiana Hist. Mag., XXII (1945), 19-29; F. D. Kershner, "From Country Town to Industrial City: the Urban Pattern of Indianapolis," ibid., XXVI (1949).

(70) B. Still, "Patterns of Mid-Nineteenth Century Urbanization in the Middle West," Mississippi Valley Hist. Rev., XXVIII (1941-42), 187-206.

" . . . no thinking man with capital will stop here when we leave only commerce to sustain us. A manufacturing town gives a man full scope for his ambitions."

The paper advocated popular subscriptions to factory enterprise, reduction in real-estate prices, consumption and protection of "home manufactures." Similar complaints were uttered by the new Milwaukee Manufacturers' Association in 1863, and the Milwaukee Sentinel insisted that "(c)ommerce alone can never give us a permanent prosperity." In 1873 the Cleveland Leader affirmed that "a thousand dollars put into manufacturing does more to gather population than a million dollars put into trade." By that date a third to a half of the working population of Milwaukee was engaged in manufactures valued at $20,000,000 a year.[71]

By the last quarter of the century, moreover, the growth of great urban-industrial centers across the continent was transforming the pattern of agricultural production and land-use. The specialized wheat belt, the corn-hog belt, the grass-dairy belt, the development of truck farming and the fluid milk business were alike consequences of urban-industrial concentration, first in Europe and then in the northeastern and central United States itself. The great cities of the American interior, moreover, had come to dominate (in the ecological sense) the economic and social life of their respective hinterlands. As early as the 1860's, for example, Joseph Medill claimed more than a quarter of a million readers for the Chicago Tribune when the population of that city was only a little over 110,000.[72] Perhaps the paradox of mid-western history lies in the extent to which in political and intellectual matters that vast region has remained essentially rural.

During the second and third quarters of the 19th century a great expansion of urban manufactures and trade occurred in all of the most dynamic economies. Between 1830 and 1880 the movement of population and resources became a veritable flood as the utilization of new fuels, materials, and mechanical aids enjoined a closer integration of productive and managerial processes. Improvements in transport and communications over long and short distances only accentuated the trend. With water and steam as the essential power base, and with belt and pulley the only, limited, means of power transmission, specialized factors were perforce drawn together under more centralized oversight and control. The rationalization of manufacturing and commerce in the paleotechnic period tended to eliminate many of the independent mercantile functions and transform them into the tasks of management. What had happened in England, the Low Countries, parts of France, and North America was repeated with local variations in western and central Germany, southern Sweden, northern Italy, and even Japan.[73] Everywhere the easy-going mutuality of the old domestic and merchant-employer arrangements gave way before the more severe master-servant relation in mill and factory.

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(71) Ibid.

(72) B. Pierce, "Changing Urban Pattern in the Mississippi Valley," Jnl. of Illinois State Hist. Soc., LIII (1950), 49.

(73) See literature cited by E. E. Lampard, op. cit., Section 5, Note 28.

Each early industrial center, however, needed engineering and machine shops, a host of storage and warehouse facilities; wholesale houses and retail shops mushroomed in their vicinity. The industrial city, in short, was a focus of technical change. New forms of business association developed in order to mobilize capital; to exploit local "wastes" and by-products. Old forms of financing and regulating economic activity became outmoded. Personnel with technical or managerial experience in local industry might open shop to finish some semi-processed material, or simply to compete with their former employer. Other firms specialized in the production of tools and parts for nearby factories and workshops.[74] The ideas and techniques of one man, as Marshall saw, were taken up by others and combined with knowledge or capital of their own. Local leaders formed committees and clubs to stimulate business and attract new energy in human or potential forms.

A number of recent studies have indicated how the location of one or two major concerns in a community -- the "town builders" or "carrier" core -- can generate a sizeable proportion of local income on which many others come to depend for their immediate livelihood or support. Borge Barfod has shown, for example, that at least 10 per cent of local income in Aarhus was directly attributable to one large oliefabrik. Its removal from the city would have the effect of six to ten thousand employees losing their jobs with the income of "residentiary" activities and local tax capacity correspondingly reduced. The work of Rutledge Vining and other economists with local areas tends to confirm the importance of this local "multiplier" relation.[75] Historical studies would probably show a comparable force exerted in the early industrial centers of the 19th century -- if only we could assemble the local income data.

6. Neotechnic Urbanization: the System of Cities

The neotechnology of the late 19th century was not a substitute for the old. It was rather a widening and deepening of technical influences in every aspect of our existence. It was mostly a direct outcome of science being applied to the satisfaction of consumer demand. This application of science to technique stemmed, in part, from man's effort to confront the many problems of survival with his unique contriving intelligence: to surmount the frictions and imperfections which everywhere inhibited a more abundant material life. The application of science was, in C. P. Snow's brilliant phrase, "a resonance to industrial needs." But applied science was also a consequence of man's ability to confront the problems of "understanding" and "knowledge" with a rational intelligence. It was the outcome, in part, of an inner dynamic in the research process, best exemplified perhaps in branches of pure mathematics where practical considerations were negligible.

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(74) C. D. Harris and E. L. Ullman, "The Nature of Cities," Annals of Amer. Acad. of Political and Social Science (Nov. 1945), 7-13.

(75) B. Barfod, Local Economic Effects of a Large-Scale Industrial Undertaking (London and Copenhagen, 1938); R. Vining, "The Region as a Concept in Business Cycle Analysis," Econometrica, XIV (1946), 201.

In 19th century economic history there are examples of both developments: scientific advances with and without immediate economic motivation. Business leaders of 18th century Manchester, for example, became interested in the problems of textile chemistry and published much research in that field. The growth of local industry thereafter made it essential to produce, and understand the working of, acids, alkalis, and soaps on an unprecedented scale. The awareness of this need led directly to an expanding edifice of chemistry which, in turn, opened up new fields of dye-stuffs and high-explosives. An even more direct example of urban stimulus to scientific progress occurred in the case of dairy and food chemistry where the economic and social problems of an industry -- "the city milk problem" -- led to the systematic study of milk constituents and the discovery of enzymes. C. P. Snow cites an example where "practical interest in the efficiency of steam engines concentrated the researches of Carnot, Joule, Thomson, who produced the major theoretical advance of the century in the laws of thermodynamics." On the other hnad, the emergence of a vast neotechnical field -- electricity -- was very much an incidental offshoot of quite different concerns. The growth of ocean navigation prompted an interest in lodestones and magnets and investigations into these problems eventually "threw off some of the simple phenomena of electricity." Yet for a long while the "fluid" was seen only as an amusing parlor game. Partly because of its chance discovery the application of Farraday's work was probably delayed for half a century. Thus much electrical knowledge was, so to speak, of its own making despite its potential significance for economic development.[76]

It was the application of electricity to power and communications media in the city which brought urban-industrial growth to a new phase; one which was to be marked with some relaxation of older centripetal forces. This change occurred at a time when the costs of congestion and other frictions had become a serious charge upon some urban-industrial centers such as New York, Manchester, or Pittsburgh. In 1911 E. E. Pratt was unable to discover a suitable measure of this cost, but he noted that it had already become a major factor in industrial relocation in metropolitan New York-New Jersey. In 1924 the cost of traffic congestion alone in New York City was estimated by the Regional Plan Association at $365,000,000 a year. In 1953 the Citizens' Traffic Safety Board reported that traffic congestion in that city was costing local business $1,082,000,000 annually.[77] But rising city taxes had also become a positive disincentive to further agglomeration; soaring real-estate values, the mounting obsolescence of plant, buildings, and transportation systems, the increasing rigidity of organized labor markets, alike contributed to an incipient flight from the city. To these centrifugal economic pressures were added the liberating force of the neotechnology -- rapid transit, telephones, the automobile, and the economical transmission of heat-energy by electric cable.

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(76) New Statesman, March 20, 1954; J. D. Bernal, Science and Industry in the Nineteenth Century (London, 1954).

(77) E. E. Pratt, Industrial Causes of Congestion of Population in New York City (N.Y., 1911), pp. 14-18; New York Times, Sept. 21, 1953.

Between 1890 and 1914 there was a noticeable growth of suburban perimeters and a marked shift of heavy manufacture to smaller satellite centers. In 1915 the American writer, G. R. Taylor, wrote his Satellite Cities as a commentary on "the great concentric outer rings of industry which powerful economic forces are flinging out from congested centers." Patrick Geddes in Britain, Herman Schmid in Germany, and F. C. Howe from all over Europe, had reported much the same development. Yet in one sense suburbanization was as old as urbanization itself, for each successive perimeter -- even in the middle ages -- had gradually been submerged in the city's outward surge. But there were now many who joyfully predicted the early demise of "megalopolis," "la ville tentaculaire," "the urban blight," and foresaw a golden, or rather, greener era of decentralization.[78]

More careful observation in such industrial countries as Britain, Germany, and the United States during the interwar years demonstrated that this centrifugal trend had been somewhat exaggerated, if not misunderstood. Those who had regarded cities merely as a passive consequence of transport developments were especially liable to confusion. There was, no doubt, a suburban trend in both population and manufactures in more "mature" centers; a trend which was aggravated by recurrent depressions. But it is not so much the broad facts which are in dispute as the interpretation placed upon them.

Some sections of American industry did shift away from older locations (e.g., some branches of clothing, textiles, boots and shoes), and some corporations opened subsidiary assembly and sales branches far from their central headquarters. This development was an inherent part of regional economic growth within a unified political-economic area. In England such changes were less marked. Neotechnic industries did grow up in suburban fringes of Greater London, but the historical "industrial belt" in central and northwestern England merely expanded old and new activities along the edge. The depressed areas of south Wales, central Scotland, and the Northeast represented not so much regional declines as the senescence of whole industrial composites in the face of economic depression and foreign competition. War industries apart, it is difficult to discover manufactures or services in Britain and the United States which have completely removed from their older sources of material, labor, or customers. In no case which we have examined does it appear that older urban activities have become rural. Even in newly developing areas, such as Canada or the American South and Southwest, it seems that urban populations are increasing at a characteristically faster rate than rural populations. It is misleading, therefore, to imply that industry has quit the obsolete urban communities of New England to enjoy the vistas and "external economies" of the rural South.[79]

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(78) C. R. Taylor, Satellite Cities, (N.Y., 1915), pp. 1-14, 262; P. Geddes, Cities in Evolution; H. Schmid, City Bildung und Bevölkerungsverteilung in Grossstädten (Munich, 1909); F. C. Howe, The Modern City and Its Problems (N.Y., 1915). Also W. Ashworth, The Genesis of Modern British Town Planning (London, 1954); P. Lavedan, Histoire de l'urbanisme: époque contemporaine (Paris, 1951).

(79) R. Heberle, "Social Consequences of Industrialization of Southern Cities," Social Forces, XXVII (1948), 29-33.

If centripetal forces have relaxed their pressure during the present century, there is still no scattering of foot-loose industry in either Britain, Germany, or the United States. It is clear that urban-industrial centers still exert -- in one way or another -- a powerful gravitational pull. We conclude that the march of economic progress has not rendered such complexes either senile or otiose. Rather has progress slowly transformed the structure and plan of the city -- its social-institutional matrix. The plant and "the plant-writ-large" have both responded to the same forces. The plant is no longer a three or four storey building but an extensive bungalow built around a "line of production." The thriving suburb and the lusty satellite, linked to their central nucleus by swift currents of rapid communication, are as much a part of "the city" as the older congested downtown areas and the adjacent blighted zones. The new techno-organizational conditions of economy have prompted a transformation of urban socio-economic structure and spatial arrangement. The changes witnessed during the past fifty years were not so much the death spasms of an obsolete or abnormal megalopolis as its virtual transfiguration before our eyes.

The studies of Sargant Florence, Colin Clark, D. B. Creamer, Coleman Woodbury and others broadly confirm this thesis. The enquiries made by Creamer and Brunck into industrial displacement are a most pertinent witness. Over the period 1899-1929, these investigators discovered considerable peripheral diffusion in the United States but little actual dispersion of urban population or manufactures. They found, for example, that cities between 10-100,000 inhabitants sustained less relative shrinkage of wage-jobs during the years 1919-33 than cities either above or below that size group. A detailed analysis of employment in 24 industries during the period 1929-33 (accounting for 44 per cent of all U.S. wage-jobs in 1929) revealed only slight evidence of diffusion in 13 durable goods industries and almost none of dispersion. In 11 semi-durable goods industries, there was somewhat more evidence of dispersion but still much less than that of diffusion. Significantly, the 4 semi-durable goods industries with a relatively large dispersional tendency showed a relatively high ratio of labor cost to value added by manufacture. Moreover, though the older centers of conurbation showed a somewhat smaller share of total wage-jobs in 1933 than in 1929, more new plants appeared in the centers than in the peripheral extremes.

Our own investigations in this area, and the authoritative study of Urban Redevelopment by Coleman Woodbury and his associates, show that the trends detected by Creamer and Brunck in the 'thirties still largely obtain. The work of D. B. Creamer and Colin Clark also indicates that both the viability and the creative force of urban centers tends to vary with their size. Size may well have become the critical feature of a city which determines its role in the economy at large. Information currently available, however, does not provide a definitive answer to this question. Nevertheless, in the economy as a whole, the studies of Sargant Florence and others seem to indicate that the ongoing concentration of functions is still a condition of increasing efficiency and a dynamism of new opportunity.[80]

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(80) D. B. Creamer and H. K. Brunck, "The Diffusion of Manufacturing Employment," in C. Goodrich et al, Migration and Economic Opportunity (Philadelphia, 1936), pp. 314-92; C. Woodbury, op. cit., pp. 286-88;

We argued at the beginning of this study that the history of economic progress was in large part the history of increasing specialization: that the integration of differentiated functions tended towards the spatial concentration of factors in urban localities; and that the concentration of differentiated functions made for further specialization. We pointed out, however, that the snowballing of specialties in a city was not simply an additive process. Sooner or later, the tendency to specialize, when unchecked by social or political barriers, resulted in far-reaching qualitative differences in the occupational structure of the labor force. Thus the progressive shift of manufactures from the country to urban sites not only facilitated specialization away from agriculture but, almost simultaneously, increased the effective demand for farm produce. Materials, so to speak, were no longer brought to the food. Though the purchasing power of the swollen proletariat was at first painfully small, the potential of urban markets led to a more discriminating pattern of land-use and the application of mechanical, labor-saving, techniques to both the tools and tasks of husbandry.

Urban-industrial concentration thus fostered a sharper division between so-called primary and secondary employments. As economic development passed into the neotechnic phase, we noticed that the impulses imparted by urban specialization were not exhausted in the simple division between food-raising and manufactures. A number of employments which involved little or no material output assumed increasing, if not controlling, significance, in the most advanced economies. The city, in fact, proved to be an even greater stimulus to the proliferation of service or "tertiary" activities.

The city throng must be fed, clothed, housed, and moved to work. While the satisfaction of these needs created new agricultural and manufacturing composites, it also enlarged the sphere for services which catered to the more personal needs of a highly urbanized population. To be sure, many of these vocations were known before the rise of the industrial city, but the market, the income, for the mass sale and consumption of specialized tertiary services is clearly a modern urban phenomenon. Time-series of occupational distribution, such as that of Weintraub and Magdoff, indicate that economic advances have been accompanied by increases in the proportion of the labor force engaged in service activities. The functional analysis of city populations, by geographers like Chauncy Harris and Robert Dickinson, gives further support to this hypothesis. A. G. B. Fisher concluded that "shifts of employment towards secondary and tertiary production . . . are the inescapable reflection of economic progress."[81]

C. Clark, "Economic Functions of a City in Relation to Its Size," op. cit., pp. 97-8; P. S. Florence, "Economic Advantages and Disadvantages of Metropolitan Concentration," discusses this subject under four heads: efficiency or not in increasing current production; efficiency or not in pattern of income; efficiency or not in increasing future income; efficiency or not in offering a variety of jobs and services.

(81) A. G. B. Fisher, Economic Progress and Social Security, pp. 6-7; C. Clark, Conditions of Economic Progress (2nd ed., London, 1951), p. 401; A. Sauvy, "Progrès technique et repartition professionelle de la population," Population, IV (1949), 59-67.

The historic drift of population from farm to city was one important manifestation of this process at work; another was the periodic occurrence of "technological unemployment." The substitution of capital and managerial inputs for labor inputs, as it were, helped produce a "surplus" of rural population which sought employment in the burgeoning factory towns. The same process of substitution was ultimately applied to the manufacturing population itself. Only in the city with its high concentration of local income could the technologically displaced persons find a new livelihood. Some, of course, followed the land "frontiers" so long as they existed, but it is doubtful whether they improved their living standards by farming or by real-estate speculation. In any case, the fact that most people ultimately enjoyed a better livelihood in manufactures or services is testimony to the progressive character of urban-industrial growth.

All this was not to imply that non-urban communities and places are inherently retarded or inert. Historically, we find that agriculture and manufacture were always carried on in intimate relation with each other; it is only in the last two centuries and under the influence of economic specialization that they have appeared to diverge so much. Nevertheless, even as they become differentiated so their mutual interdependence increased. Today the greatest metropolis depends on farm and forest for most of its food and fibers, and the country is no less dependent on the city for the sale of its huge surpluses in exchange for the variety of consumer goods which make up the farmer's standard of life in an economically-advanced area. Indeed, perhaps only in a "backward" area does the rural standard of life lag far behind its urban counterpart; only in an underdeveloped area does rural economy retain such a large subsistence sector.

If the early industrial phase was marked by a growing differentiation of urban and rural socio-economic structures, the later industrial phase has witnessed a progressive urbanization of all economy and all society. In the economically advanced areas, there is no longer, if indeed there ever was, a complete divorce of town and country in either the economic or social sense. The one merges almost imperceptibly into the other wherever the industrial process has long prevailed.

Thus no city is ever an island existing in and of itself. The examples of Vienna and Berlin after two World Wars graphically illustrate what happens to a modern metropolis when it is abruptly severed from its hinterland. Every city, no matter how large or small, functions in relation to, and as an integral part of, the wider economic order around it. In some cases this mutuality corresponds to a whole region or country. A few great centers are aptly termed Weltstädte. To understand the situation prevailing in any particular place it is necessary to examine its more or less unique relation to its environing economy.

Donald Bogue has developed the hypothesis, suggested in earlier work of the economic historian Gras and the sociologist McKenzie, that great cities "dominate" the surrounding social and economic organization of their hinterland. A set of four bio-ecological categories was adapted to mark the functional interdependence among four levels of population density and applied to

each of 67 metropolitan areas embracing the entire United States. The metropolis or dominant, which exerts a singular functional control over the metropolitan area, was generally defined as a city of 100,000 or more inhabitants. Smaller cities in the same area exert a similar, though much more limited, influence over their social and economic environment and were classed as subdominants. Villages and other centers of rural non-farm population, which exert only minor control, were termed influents. Scattered clusters of rural farm population, subinfluents, have little or no control but are themselves subject to one or more of the larger concentrations. It was argued that the characteristic distribution of population in the area reflected the ecological effect of distance in that numbers of persons per square mile decreased as distance from the metropolis increased.

The distance patterns of population density were then compared with corresponding patterns of occupational distribution in four so-called "sustenance activities" -- retailing, wholesaling, services, and manufactures. Each pattern broadly resembled the others yet differed in significant detail. Every activity had its own characteristic degree of concentration or scatter about the metropolis, indicating that working population in some localities was more specialized than in others. For example, in the metropolitan area as a whole, manufacturing was mostly confined to a belt within 45 miles of the center whence it served the needs of -- dominated -- the entire area. The regularity of such patterns was, of course, interrupted by sectors along inter-metropolitan and dominant-to-subdominant routes which also inclined to manufactures. Almost all areas of specialized activity in the hinterland were thus supplementary to and, in that sense, dependent on the larger conurbations. Bogue concluded that the modern metropolitan community was

> "an organization of many subdominat, influent, and subinfluent communities, distributed in a definite pattern about the dominant city, and bound together in a territorial division of labor through a dependence upon the activities of the dominant city . . . this, has come to be a characteristic pattern by which at least one urbanized commercial-industrial society, the United States, is organized."[82]

7. Some "Lessons" for Underdeveloped Countries

(a) The general prospect for urbanization and economic growth: It will be clear from our earlier argument that urbanization on any scale (say with upwards of 40 per cent of population in cities 2,500 plus) is closely bound up with greater specialization of functions in industry and agriculture. The concentration of specialized factors in locally-integrated sequences is, in the light of the experience of advanced areas, a condition of higher productivity in most

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(82) D. J. Bogue, The Structure of the Metropolitan Community: A Study of Dominance and Subdominance (Ann Arbor, 1949), pp. 61-3. For some commentary on Bogue's hypothesis and related studies of R. E. Dickinson, W. Christaller, G. Chabot, G. K. Zipf, J. Q. Stewart, J. E. Brush, and R. Vining, see E. E. Lampard, op. cit., Section 5, passim.

branches of manufacture. It also contributes to the over-all rationality of the economy. To some extent, though this is less well established, concentration of specialized activities in cities tends to foster further specialization and hence greater economy. In a progressive economy cities function as dynamic centers for innovation and change.

Certain observations follow from this general theoretical position and from the evidence of economic history. If backward areas embark on industrialization programs, or if, like Topsy, industry just grows, then it is likely that there will be more and larger cities. As the economy develops, the cities will tend to become more varied functionally, i.e., more specialized in their basic "carrier" activities and mutually interdependent. They will lose some of their local character and acquire a metropolitan or even national significance. The resulting increases in local income, however, will exert a "multiplier effect"; possibly generating more secondary activity and almost certainly more specialized tertiary activities which are essential to a higher standard of living.

The extent of local specialization is, in part, an outcome of the changing balance which is struck between internal and external economies of concentration as against the various friction-costs of locating elsewhere; (quality of transport service, structure of freight rates, and site rentals). Backward areas may suffer from a critical lack of these important external economies which, in older centers of industry, stem from the existence of an urbanized, disciplined, skilled labor force, the concentration of consumers, and the availability of essential commercial and service functions, etc.[83]

The record of industrial development in such old manufacturing areas as southern Lancashire, the Birmingham Black Country, the Delaware Valley, northeastern New England, the Ruhr, or Flanders, is testimony both to the dynamic effect of local concentration and to the enduring significance of external economies. The accretion of manufacturing functions around great seaports (which are also great markets) such as Liverpool, Glasgow, Belfast, London, Antwerp, Hamburg, Genoa, Marseille, New York-New Jersey, shows that old mercantile entrepôts may likewise become a focus for industrial growth. The same holds for the inland junctions of transportation networks; like Chicago, Paris, Frankfurt-am-Main.

Morse's account of São Paulo, Kershner's study of early Indianapolis, Ghosh's picture of recent industrial trends in Calcutta, suggest that old commercial-administrative centers of raw material producing regions may also become economical locations for manufactures.[84] There, at least, are ready markets, some tradition of urban life, and constant pressure to secure a livelihood from non-farming activity. On the other hand, it is also clear that the mushrooming of industry in a commercial metropolis sometimes

(83) W. J. Baumol, op. cit., pp. 165-66.

(84) Cf. F. D. Kershner, op. cit.; R. M. Morse, "São Paulo in the Nineteenth Century," Inter-Amer. Econ. Affairs, V (1951); S. Ghosh, "The Urban Pattern of Calcutta, India," Economic Geography, XXVI (1950), 51-8; P. George, La Ville, pp. 300-02.

places an unbearable strain on existing sources of power, essential municipal services, and housing. To remedy these deficiencies of the moment may well involve draining off scarce capital resources from more productive outlets.

Though cities of great size develop as the commercial-administrative centers in backward areas, they are nevertheless few in number and far between. They are mostly seaports which dominate natural approaches to vast areas of underdeveloped hinterland from which the advanced countries have long obtained part of their raw material and food supply. Such places resemble New York or Boston in their colonial phase, the mercantile capitals of dependent economies. The urban settlements behind the capitals are likely to be small mining communities, local markets and collection points, agricultural villages, strategic centers for communication or defense. In such circumstances the large capitals are confined in their range of functions, not by the economic competition of other cities, but by the quantity and variety of workable, accessible, resources in their immediate hinterlands. The growth of the mercantile capital and the smaller settlements as manufacturing centers is retarded by the inadequacies of existing transportation facilities. This has been particularly important in parts of Latin America and India which have long-established but still skeletal railway systems.

Thus the presence of an overly large city in a preindustrial society may act as a curb rather than a stimulus to wider economic growth. Its growth and maintenance have been somewhat parasitical in the sense that profits of trade, capital accumulated in agricultural and other primary pursuits, have been dissipated in grandiose urban construction, servicing, and consumption by a "colonial" élite. The labor and enterprise which might otherwise have been invested in some form of light manufacture or material processing in the interior are drawn off to the great city by the attractive dazzle of a million lights. To that extent, the development of mercantile capitals retards development of other productive potential.

(b) Cities and rural development: While the case for urban manufacturing is generally unanswerable, it is equally true that an improved husbandry was essential in the development of the advanced economies. The advantage of the city, in fact, may not be so impressive in a preindustrial society and many opportunities for growth exist in the rural areas.

The history of the advanced areas, particularly in the early industrial phase, supports this plea for a reappraisal of rural opportunities. Much of the early capital invested in the industrial revolution of Europe and North America came from the country districts. Metropolitan credit used in the discounting of bills in 18th century England was not infrequently based on a surplus derived from agricultural and cottage industries. The importance of Norwich as a financial center stemmed in part from its situation in the center of the great East Anglican farm and domestic manufacturing belt. Much capital invested in the Ruhr a century later was accumulated over the years in the semi-rural industry of the surrounding valleys.[85] The same is true of

(85) N. J. G. Pounds, The Ruhr (London, 1952).

the American Middle West where a growing specialization on the farm during and after the Civil War made centers like Milwaukee, St. Louis, Chicago, and the Twin Cities important commercial and commodity markets before they developed their manufacturing functions. Similarly, some of the capital used (and abused) in attracting railroads also had its origins in the productivity of the rich farm land.

It is possible that some underdeveloped areas would progress further, in the long run, if they invested and reinvested their meager resources in agriculture and rural industry. Not only would they help accumulate more capital for the future, but would lessen the tendency for urban development to get out of step with the rest of the economy.

(c) The cost of cities: Some of the costs of cities were mentioned during the discussion of the paleotechnic phase in Europe. It is not possible to recall them again now at any length. Nevertheless, certain experiences from the advanced areas may be relevant to the situation existing in underdeveloped countries today.

Let us look merely at the city's physical plant. Housing of the working classes has been one of the greatest "failures' in the record of industrialization. In paleotechnic Britain and the United States building was essentially a speculative enterprise and, as such, had to compete in return with railways, manufactures, overseas investment, private and public securities. This it generally failed to do. Under such circumstances there was no effective way of avoiding excessive building densities in working class districts. There was likewise little effort to improve the city landscape in public areas with commodious or tasteful social buildings, such as had been the glory of the classic city states and medieval towns. Even the churches lagged for a long while in Britain and tiny tin chapels became an eye-sore. T. S. Ashton has made a vigorous defence of the speculative builders in the decades after the Napoleonic Wars -- their lack of experience, the high cost of even inferior materials, their small-scale operations often conducted on a three months' credit which was difficult to obtain while the usury laws were in effect, the burden of import duties on lumber, the taxes on more spacious and well-lit accommodations.[86] All this is true but would be more convincing if there were any period later in the century when things were radically different. The housing situation is still unsatisfactory in many advanced industrial areas despite the large public programs which got underway during the interwar years.

In the course of industrialization other expedients were devised to cope with the housing predicament. Employers sometimes found it profitable to provide their workers with accommodations nearer the place of work. Along with company housing there often went the company store, company utilities, and even company morals. This had the advantage of reducing the time and expense involved in the journey to work, but it tied the employee to the firm with an almost medieval finality. The horrors of such comprehensive

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(86) T. S. Ashton, in F. A. Hayek, ed., Capitalism and the Historians (Chicago, 1954), Ch. 1.

establishments have sometimes been exaggerated by reformers, but their effect -- as G. R. Taylor's account of Gary shows -- was often disastrous. W. E. Chaloner's excellent history of Crewe, however, points to a more reassuring record in the case of railway housing; while Gerald Johnson's apologia for the early North Carolina mill towns emphasizes that there was often no other agent than the company to build the houses, run the store, extend the credit, make and enforce the law.[87]

Later in the century building societies and municipalities made ventures in low-cost housing which effected some remedy, yet new construction seldom kept pace with replacements and the needs of a rising population. Two other 19th century developments in housing were significant. Towards the close of the century the growth of a professional and "white-collar" class -- the middle strata of governmental and business bureaucracy -- led to extensive developments in the suburbs of industrial and commercial cities for the middle-income groups; and the movement for "garden-cities" and town planning gathered momentum. Of course, the provision of housing on any scale is bound to involve public authorities: roads must be built, sewerage and other essential utilities provided such as water, gas, waste-disposal, etc., schools and transportation services. Even if the community does not provide these services by municipal enterprise, there is always the need for regulating private undertakings in order to obtain a minimum of order and efficiency.

The growth of cities necessitates a revolution in local government only less profound than that which occurs at the national level with the advent of an industrial society. In local affairs the debate usually centers round the closely related questions of powers and finance. The problems of housing, construction, and urban redevelopment which we have briefly mentioned served, historically, to focus attention squarely on the competence and resources of local authorities. In this respect the experience of England or the United States is typical, since in France and Germany greater power always rested with the central government at national and state levels respectively. Much piece-meal planning was accomplished in early 19th century England under the successive "Improvement Acts." In Liverpool the use of such reforming powers dates back to 1786; we have already seen how Manchester soothed some of its growing pains with the Improvement Acts and the Police Commission. The Improvement powers, however, were never adequate to contain the powerful impact of the industrial revolution. Even after the Municipal Corporations Act of 1835, local authorities were unable to meet the challenge effectively. Apart from the police power, responsibility was still divided among other Boards and Commissions. If, as William Ashworth explains, the reformed boroughs received more liberal constitutions, the Act "did nothing to make them into more effective administrative instruments." The spread of cities thereafter added the new problem of areas to the older questions of powers and finance. The vast amount of permissive legislation produced by Victorian Parliaments likewise proved

(87) G. R. Taylor, op. cit.; W. H. Chaloner, The Social and Economic Development of Crewe, 1780-1923 (Manchester, 1950); G. W. Johnson, Making of a Southern Industrialist: A Biographical Study of Simpson Bobo Tanner (Chapel Hill, 1952).

ineffective, while the growing sphere of mandatory regulation suffered from the lack of adequate enforcing bodies. The solution, if such it can be called, only came relatively recently with the establishment of powerful local planning and development authorities charged with the over-all control of wider areas and with considerable financial backing from the national government.

While recognizing the capital cost of planned development and conceding the complexities involved in financial aspects of planning legislation, it is suggested that many underdeveloped areas can hardly afford not to plan. Public authorities should provide a master plan for every community and, where necessary, supplement the activities of private investors in such critical segments as housing and utilities. Furthermore, they must be furnished with ample enforcement power in order to make good their regulatory gestures. This is surely a lesson from the advanced areas which must be apparent to all. The social costs of chaotic growth have been a burden on almost all the developed communities; they are responsible, in part, for some of the deeper antagonisms and tensions which still plague the social scene. Of course, people who have never known anything better may become reconciled to bad conditions, e.g., the Puerto Ricans in New York City. On the other hand, they may not. Where real-wages are unlikely even to reach the levels of the most recent immigrants in New York, the proliferating chaos of "shanty" towns from Johannesburg to Karachi may prove a perpetual source of instability and disorganization. Such conditions in a city are seldom conducive to healthy socio-economic growth.

We learn from the pages of the Lowell Offering that this lesson was recognized in some measure by the builders of certain New England textile towns over a century ago. For all the "paternalism" of Lowell, it was as Whittier said a "modern miracle." The accommodations and environment provided for the mill girls was infinitely preferable -- from a cost standpoint -- to the kind of situation reported from Manchester and its satellites in the previous decade. If the builders of Shenandoah, Pa., Granite City, Ill., and Birmingham, Ala., were later to forget these lessons, it would be unwise for the realtors and their industrialist colleagues in the underdeveloped areas to presume upon the same good fortune.[88] One only hopes that the authorities will learn another vital lesson from our experience: that it is folly to plan for a community without a viable economic base.

This problem applies not only to the planning of existing towns but to the location and development of new ones. The cost of any city which, for some reason, fails to earn its living will sooner or later be paid by other communities. Alternatively, the city will be depopulated and die. There are, for example, towns in the American west or the Brazilian interior which were formerly centers of prosperous range and mining businesses, but which soon declined with the exhaustion of their seams or the failure of their water supply. There are ancient ruins of towns in North Africa which were flourishing Roman garrisons but which rapidly decayed once the soldiers were withdrawn and the aquaducts fell into disrepair. Despite the wonders of modern engineering

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(88) G. R. Leighton, America's Growing Pains (N.Y., 1939).

exhibited in Los Angeles, there may still be areas which are incompatible with any self-sustained urban development and where it would be absurd to locate a city.

(d) Cities and development: The emphasis which economists usually place on the transfer of capital from advanced to backward areas has given the word "development" a peculiarly abstract, mechanical meaning: X inputs will result in Y outputs, and so on. A fuller understanding of what is involved in the change is required of all those who are likely to be "developed" in the near future; some pause may even be given the "developers". It is hoped that our emphasis on the city as a producer and product of capital will provide a somewhat less mechanical, more humane, perspective on the process.

As it is, many recipients of technical assistance maintain a curiously ambivalent attitude towards western society on the one hand and western knowledge on the other. While some seem anxious to embrace a western mode of living in its entirety, others reject our methods and manners but adopt the machines. A few ascetics wish to have neither the manners nor the machines. These attitudes may not be so significant as the pessimists would have us believe. Kenneth Little's recent description of the "new social order" emerging in Sierra Leone, under African leadership but on joint African-European initiative, is very reassuring. The human being is surprisingly resilient and, where a population is akin to ourselves in its cultural tradition, these problems may well be academic. But once the stress and strain of change are really felt, one wonders how long the ambivalence can be maintained: some change of view will surely be enforced on all sides.

The industrial revolution in Europe and America was not produced by savings and investment. As S. Herbert Frankel insists, the great capital accumulation in the advanced areas over the last two centuries was not the outcome of mechanical forces described in the text-books but due "to the evolution of new patterns in social relationships . . . to the emergence of new types of social activity." Gandhi seems to have grasped this aspect of "development" better than many of the civil servants. The more he considered making India over in western image, the more he preferred for his people to return to village life, tend their fields, sit on the floor and twiddle the charkha in order to spin enough cloth for a khadi or two. He cared less for "saving" than for the "saving of souls." It is a curious irony that so many of his most devoted and demonstrative disciples are also Fabians, believing in a well-administered, economically advanced, welfare state. His spirit and their intelligence may yet combine to produce a viable solution in India.

But the emergence of many "new" types of social activity within a brief span of time is likely to involve serious social consequences. Saving, wrote Frankel, is

> "not a mechanical act, but the result of new attitudes in social behaviour. To repair and maintain; to think of tomorrow not only of today; to educate and train one's children; to prepare oneself for new activities; to acquire new skills; to search out new contacts; to widen the horizon of individual experience; to invent, to improve, to question the 'dead hand of custom,' and the heritage of the past -- in all these

> and not in mechanical caluculations, or mechanical regimentation, lay the causes of capital accumulation. For indeed capital was but 'accumulated' in the ledgers of the counting house; in the objective world it was embedded in the general stream of changing activity, in world-wide migration, in the co-operant bonds of commerce and mutual confidence, and in painfully created new aptitudes of action and responsibility."

In the objective world, the general stream of changing activity concentrated millions of people into urban-industrial centers which became "the social milieu of a new structure of behaviour and thought."[89] Our modern society received its characteristic stamp from urban institutions, roles, and personalities. Older traditions disintegrated; human behavior became more diversified and yet in some ways more uniform. In the subjective world there was also a great transformation; for the change from rural-agrarian to urban-industrial affected almost every aspect of existence. The great cities eventually came to dominate the intellectual, social, and economic life of their hinterlands.

In 1891 Lyman Abbott asked, "What shall we do with our great cities? What will our great cities do with us? They are two questions which confront every thoughtful American." Today the people of an urban-industrial society are perhaps adapted to its routines and more reconciled to its norms. But after sixty years there is still some urgency to Abbott's questions and we do not have an answer, except perhaps to say that such questions shouldn't be asked. Sixty years before him the first generations of city dwellers had posed much the same questions; many had replied by resisting the new society with all their strength.

The present generation of "urban immigrants" in backward areas will certainly learn something from our experience; yet their predicament closely resembles that of the uprooted Chartists and Jacksonians a century or more ago. It is doubtful whether the new urban society will fully meet their needs. For they are mostly rural folk in taste and experience and they will find themselves "wrestling with the most difficult of all spiritual adjustments, forming a new social mind, disturbed by changes that have destroyed the basis of custom in their lives."[90]

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(89) S. H. Frankel, The Economic Impact on Underdeveloped Societies (Cambridge, Mass., 1953), pp. 69-70. Also, J. Viner, "America's Aims," in B. F. Hoselitz, ed., The Progress of Underdeveloped Areas (Chicago, 1953), pp. 193-95.

(90) J. L. and Barbara Hammond, The Bleak Age (London, 1934), passim.

SPATIAL ORDER AND THE ECONOMIC GROWTH OF CITIES: A COMMENT ON ERIC LAMPARD'S PAPER

Although I was asked to introduce the paper of an economic historian, I was given to understand that the reason for my being invited to this conference was really that I am interested in location theory and, in particular, that I had read Lösch's Räumliche Ordnung der Wirtschaft.[1] My remarks are, therefore, to be understood as theoretical comments inspired by Lampard's paper, rather than as specific criticisms, which I, not being an economic historian, would not feel competent to make. At the same time, my comments are intended to throw also some light on Hoselitz's distinction of generative and parasitic cities. And it is inevitable that they also bear a family resemblance to what Rutledge Vining has to say on the concept of a system of cities. I shall deliberately limit myself to economics, without, however, implying any disrespect or lack of importance to sister disciplines and other ways of looking at the problem.

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I want to start out with the obvious observation that cities have grown mainly during the period during which population has increased manifold, during which technology, including the technology of agriculture and of the means of communication, has undergone enormous changes, and during which markets and world trade have expanded. I have nothing to say to the problem in how far these facts are interrelated, in how far, for example, population is the cause or the result of industrial change. There can, however, be little doubt that the facts mentioned have contributed to the urbanization of Western Europe and the New World in the Western cultural orbit.

Since agriculture is as yet essentially an areal pursuit, while industry can be built up on a relatively concentrated area, the necessity to feed a greatly enlarged number of people without a falling, or even with a rising standard of living, enforces a concentration of population in cities, since an overcrowding of the land devoted to the production of food would normally lead to a fall in productivity. Already this remark has some relevance to the function of cities: to take sufficient numbers off the land to permit a more productive use of the soil. It need not be added, however, that much more than this is needed.[2]

This by itself says nothing, however, about how these cities are distributed in space, and what their relations are to each other or to their hinterland. Nor

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(1) A. Lösch, Die räumliche Ordnung der Wirtschaft, 2nd ed., Jena, 1944. Translated as The Economics of Location and to be published by the Yale University Press sometime during 1954 or early 1955.

(2) It is, of course, known that cities have, for various reasons, good and bad, an attraction to the most lively elements of the population. But whether it is the pull of the cities or the push of the country which brings about the urbanization is of no particular interest in the present context.

does it say anything about the functions of these cities. The only thing the mentioned facts permit us to say is that increasing population together with improved technology enforces concentration in cities; that the increased population could not have been fed at increasing standards of living as it has been, except through the development of industry and trade, and that, in particular, the large increases in population could not have been absorbed through increasing the density in the agricultural land without a fall in the standard of living, or at least without foregoing the increase which did take place. Put slightly differently, the increased division of labor, the increased specialization and concomitant need for closer communications leads to the agglomeration of population in cities. (See also below, footnote 11, p.143.)

II

In order to get from these generally accepted propositions[3] to the system of cities of Vining and the distinction of generative and parasitic cities of Hoselitz, and in general to the role of economic factors in the explanation of the growth and location of Western cities, I want to make use of some of Lösch's ideas which I intend to develop further in a particular direction, for which Lösch is not to be made responsible.

What characterizes the developed regions of the world economically is, basically, that every consumer has access to every good that is produced; that every consumer lies within the market area of each good. This does not mean, of course, that every good is produced everywhere. Nor does it obviously mean that every consumer will in fact consume every good if taste or income prevent him from doing so. It does, however, mean that the production of every good is so spread over the area of developed regions that each consumer can, within the limitations of his income and tastes, buy every good he wishes at a cost he can afford to pay. What follows from this assumption can be briefly sketched. It cannot as yet be worked out in precise detail. And because of the interrelationship of the movement of population and of production it is possible that the problem is insoluble.[4]

Suppose I start following Lösch with the deliberately unrealistic assumption that population is initially evenly distributed over an area, with a density which depends on the fertility of the soil; and that soil of equal quality and other resources are evenly distributed over this area. It is easier to introduce the facts of life into this abstraction later than to start out with irregularities and to try to make sense of them. For large areas like the American Midwest or the industrial belt of the Eastern Seaboard, or even England (the latter two because water transport is so cheap as to virtually annihilate distance) this is not as bad an assumption as it may seem at first.

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(3) It is surprising, however, how often the fact of population increase is forgotten in the literature of urbanization, particularly by more romantically inclined authors.

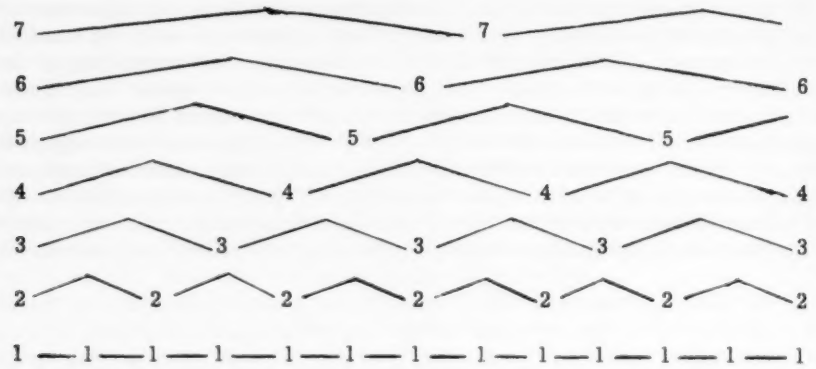
(4) The problem in its full generality is: what is the optimum distribution of the production of all goods and the location of all people if all goods and all factors (except perhaps land and certain natural resources) are mobile at a cost. Professor Koopmans has suggested in a lecture at Ann Arbor that at present there exists no mathematics which could handle this problem.

In this system a producer in a particular spot will draw customers from the neighborhood until the good becomes too expensive to ship. When this is the case a second, third, etc. producing center can arise which supply and live off their own hinterland. Each good will have a characteristic distribution which depends essentially on the size of the optimum plant (barbershops vs. automobiles) and the level and structure of freight charges. Although some goods may have the same market areas, this would be accidental and not a logical necessity. It is also clear that some of the production centers of the area will coincide, and that neither the distances between points of coincidence, nor the number of production centers coinciding can be entirely accidental.

In the Lösch system, of which the Christaller system is shown (by Lösch) to be a special case, the networks of the individual goods produced are rotated until a maximum number of producing centers coincide; this is done in order to minimize transport charges. But even without this rotation and the mathematics inherent in them -- no complete proof is, incidentally, given either by Lösch or by Christaller, and as indicated such a strict proof may not be possible -- it can be seen how the fact that (a) different goods have different sized market areas and that (b) every consumer lies within the market area of every good, gives rise to a system of cities. Where all industrial goods are produced a metropolis will arise; and depending on how many goods of what size are produced in a given spot, we will get western industrial cities of different sizes.

This state of affairs, which will yet have to be modified in different ways which Lösch does not consider, can be schematized as follows: For purposes of the schematization and because of the hinted difficulties of a general solution, I assume now that the possible locations of centers of production A, B, ... are not to be derived but are given. The numbers 1, 2, ... refer to goods with progressively larger necessary sales radii. The locations A, B, ... lie on a straight line on the schema, but it must be imagined that the distribution of production schematized in a straight line due east from the metropolis only exists also in all directions.

Since good 1 is a typically local good with a small sales radius, it will be produced everywhere. Good 2, on the other hand, will skip one location as shown, and the distribution for goods 3, 4, 5, etc. is assumed as indicated. This, to repeat, is a schema arbitrarily constructed to make a particular point, but different particular assumptions would not have changed matters greatly, as long as it is still assumed that the sales radius of a good with a higher number is greater than the one with a lower number. The sloping lines are price gradients for each commodity, the steepness depending on freight rates. They indicate also where customers living in a particular area will shop for a particular good.



Number of coinciding production centers roughly equal to size of city if population is proportional to number of industries. If population is proportional to size of industry, population size distribution would be:

A	B	C	D	E	F	G	H	I	J	K	L	M
28	1	3	4	7	6	12	8	7	4	8	1	16

Even in this simple and as yet unmodified scheme a number of things are apparent: there are more small than big towns, and the big cities are further apart. More important is that towns of the same size do not necessarily produce the same goods. So we find in the schema that town C produces only the two smallest scale goods 1 and 2, while the equally small town H produces the largest scale good (examples: Hormel in Austin, Minnesota or Studebaker in South Bend, Indiana). Conversely, the same goods may be produced in different sized cities (examples: South Bend and Detroit; Pueblo, Colorado and Chicago for steel).[5]

This can be generalized by saying that the same sized cities need not and in fact probably will not have the same functions, as far as purely economic factors are concerned.[6] In particular, there is no necessity (and often no truth)

(5) This is so if population is proportional to the number of industries. If population is assumed to vary with the size of industries, it is found, for example, that town H, producing goods 1 and 7, and town K, producing goods 1, 2 and 5, have the same size.

(6) The only function all cities appear to have in common seems to be to reduce or minimize transport cost and to lead to the establishment of an efficient system of market areas. But this is in a way the assumption on the basis of which we have tried to explain the distribution of cities, and not a separate conclusion.

in the statement frequently found that large scale industry necessarily congregates in the largest cities. Nevertheless there is a system of cities. (Our numbers are perfectly general; they may refer as easily to services as to industry proper.)

Secondly, though the agricultural hinterland is not specifically shown in the schema, it is clear from what has been said that each farmer or peasant also is within the market area of every good either indirectly in his nearest town, or directly by going to the big town within his reach. His business has been as necessary for the establishment of the industries in the various places as the business in the other industrial and service centers. This can be generalized by stating that the cities and the country have been in Western countries integrated into a functioning whole by the market economy.[7]

With this statement we may be able to lay our finger on one of the crucial differences of the role of cities in developed and in underdeveloped countries. In developed countries, cities are on the whole generative in Hoselitz's sense, in that they perform functions not only for themselves and their like but also for their hinterland on which they depend for supplies and markets. In underdeveloped countries cities are apt to be "parasitic" in Hoselitz's terminology, in the sense that their physical hinterland is neither their market nor their supply area, that for all practical purposes their physical hinterland might just as well be on the moon. Batavia, Rio de Janeiro, etc. are examples of what I am talking about. They drain off a few supplies for export, but little of the imports filters back into the hinterland. This may be due to the historic fact that cities like Batavia or Shanghai are western outposts in a foreign civilization, possibly even held in this position by the will of the foreign civilization.

In economic terms the characteristic of these cities seems to be that with few exceptions they neither buy from nor sell to their hinterland. The enormous differences in standards of living, partly expressed in large variations in wages which cannot be explained economically and which do not necessarily set off migrations as they are apt to do in developed countries, are the most important outward expression of what I mean to convey by the expression that in underdeveloped countries people living in the cities have access to all goods, but not people living in the hinterland. Differences in the standard of living of the bulk of city dwellers may not be the only factor. In part, the clash of two civilizations means that the goods produced in the cities have no market in the physical hinterland. But as long as there are physical means of communication, a person could, of course, buy any good anywhere provided he is willing and able to pay the freight charges.

Even without the modifications presently to be introduced the scheme has to be taken cum grano salis. Even in the United States not everyone has easy or cheap access to, say, a repertory opera house. Yet the enormous spread of such articles as electricity and electrical appliances, or cars, and the fact that

(7) This is true to a much greater degree than romantically inclined economists seem to believe, who talk about organic interrelations which may or may not have existed in the Middle Ages.

almost everyone in this country lives near a good road, is a source of astonishment to a visitor even from "developed" Western Europe. That in this country the ideal picture is not met with is due more to the dynamic nature of the American economy and the fact that equilibrium has not been reached, while in underdeveloped countries there actually appears to exist a kind of equilibrium different in kind from the one found in the Western world.

One last comment before turning to modifications: the schema, by bringing out one essential difference between cities in developed and underdeveloped countries, makes it possible either to integrate sociological and historical factors into it or, vice versa, permits it to be integrated into sociological and historical schemata. The well known historical fact that as long as transport was badly developed cities must remain small, and fairly evenly distributed, as in medieval times, and huge cities must have other than purely economic raisons d'etre, fits. But so does the other fact that only some of the many historically given sites actually did grow into modern cities, and not all of the historically existing administrative centers have become important industrial centers.

III

The preceding remarks were in the nature of a digression as far as the main concern of my comments is concerned, which deal, following Lampard's paper, mainly with cities in developed countries, i.e., in areas in which certain economic and social attitudes, specified and analyzed by sociologists, are taken for granted. I turn now briefly to modifications of a non-economic nature.

The first and most obvious is that neither soil quality nor other resources are evenly distributed. With good soil, the initial density of population will be greater than with poor soil. Hence cities may be both larger and closer together. As far as the theory is concerned, good land is a good reason for the growth of industry and of cities. The American Midwest,[8] the heart of both agricultural and industrial power of the United States, with an abundance of good soil and water, is an excellent example of this. However, with a growing population and with cheapening of transportation, other areas can become good sites.[9] Similarly it has been noted by geographers and historians that modern cities are apt to lie in the great coal basins of the world. Even where true -- one look to Italy shows it not to be universally true, but another look to England and Northern Europe shows the degree of truth in this generalization -- it is apt to explain too much. Coal basins are extended, and within them there is a distribution of cities. In the American mountain states there is plenty of coal which is not used (and not particularly for the reason either that iron ore is far away) and which with growing population will be used. Moreover, the coal areas happen to coincide also to a greater extent than is usually realized with food producing areas

(8) The central region of the United States had, in 1949, 26.7% of the population of the U.S., 15.1% of the land area, but 28.9% of crop land or farms, 27% of the number of farms, and 23.4% of agricultural employment. It had 33.5% of employees in manufacturing establishments, 29.09% of income payments (9% above the U.S. average), and produced 36% of value added.

(9) See the next section.

of good soil. Even the Ruhr, for many purposes a city of 20 million, has large, green, fertile, intensively cultivated areas,[10] while the export surplusses of grain of Eastern Europe have been frequently made possible by a low standard of consumption rather than by a spectacularly high level of production.

These remarks should suffice to indicate that differences in factor endowment do not wreck the approach sketched, and are in fact without it inadequate to explain really the development of cities.

The second modification relates to the role of government. This is particularly useful to introduce here, because government, even within the Western world and even within a general free enterprise set-up, plays a very diverse role. The United States and the older (pre-1914) Germany are examples of federal states. Yet in the former the government has played an exceedingly small role, not only economically, while in the latter it has always been important. Consequently, Washington, D.C., Springfield, Illinois, and Lansing, Michigan have not until recently developed much industry, and in America Boston or Providence remain exceptions; while in Europe Bern and Karlsruhe, which until the recent past have been almost exclusively administrative centers, are among the exceptions. It would, of course, be easy enough to name even in Germany other well known administrative (and cultural) centers whose industries were comparatively insignificant: for example, Dresden or Darmstadt, though even those two cities have developed important industries in the last twenty years. Yet as a rule most major administrative centers also have been important industrial, trade and transport centers. (Munich, Stuttgart, are examples of the former; Cologne, Düsseldorf of the latter.) For more centralized states, a contrast between England and France can probably also be found.

From the standpoint of the theory sketched in this paper the importance of the role of government, particularly so of a more centralized government, lies in the fact that it eliminates possible locations of industries, leads to greater concentration of production centers[11] (unless deliberately counteracted) and thus leads in a way to a simplification of the structure of the system of cities. If a peasant has to see some official or other in the next town anyway, he will do his shopping there in preference to other places, which would be more convenient if he did not have to go to the administrative center anyway. It seems self-evident to state that the pull of the administrative center will be the greater the greater and more frequent the necessary contact with it is. This would be true

(10) On the other hand, many areas of great mineral resources not only do not give rise to cities, but are not particularly rich. It is an interesting experience to talk with Iranians or Iraqis who are apt to talk of their country's economic development as if the oil found there had nothing to do with the country.

(11) There is also a self-reinforcing tendency of concentration and agglomeration (in Alfred Weber's terminology) for economic reasons alone. Cities are compact markets for goods and for this reason attract further business, since the compactness absorbs less of the available purchasing power for transport. This is only an incidental remark in this context, though in a treatment of location theory as such it would deserve much more than a footnote.

even in economies which are not socialized, in which the government does not own factors of production, but licenses and otherwise regulates intensively. The earlier pull of church centers leading to market is of a similar nature. Yet even in those cases the initial population density will make itself felt; even medieval fairs are fairly evenly distributed in space, bishoprics are established as needed, and centralized government is apt to become more decentralized when the need arises (through field offices, branches of the Federal Reserve System, fiscal agents, etc.). I believe it fair to say that again the modifications and simplifications introduced do not wreck the initial schema.

IV

Finally, a few words are to be said about economic reasons which will modify the schema of section II substantially further. The difficulties with the schema there presented are that town A produces all goods 1-7, sells at least some of them as far as town D, but does not buy anything from the towns it sells to. This would lead to the chronic imbalance in the balance of payments familiar on a larger scale as the "dollar shortage."

Now there are at least three ways out of this dilemma, both bearing directly on the problem of town formation. There is, first, triangular trade between towns and country. Town A being big buys enormous amounts of food from the country, which will spend the money in the nearest town, say C, which in turn with the proceeds from sales to its agricultural hinterland can buy good 3 in D and the others in their next supply center.

This is a possible solution. Even if good 1 is, say, haircuts, and a barbershop is the only "industry" of town B, the barber makes enough money to buy what he needs and wants (within his income and tastes, of course). But this is not a very likely solution in an advanced country. For one thing, the percentage of employment in agriculture as compared to industry is low and the net value of production in agriculture is even smaller compared to "value added" in other fields of endeavor. Although farmers do not live on a much lower plane than city people, they are not as a group much better off either. Complete reliance on triangular trade would probably require incomes in farming to be substantially higher and incomes in outlying towns to be substantially lower than they are in America.

However, the latter is precisely what can be observed in many underdeveloped countries, though not the former. The concentration of production in one big city means there that the incomes of both the country and the other towns are low, and these other sectors of the economy do in fact have to do without many of the goods produced in the central town A. The "dollar shortage" is, in other words, solved by the equivalent of exchange controls and import restrictions; the equivalent being poverty. And the central town A produces in effect for itself. This is the second, the underdeveloped, way out of the dilemma.

The third way of solving the inter-local balance of payments problem is through a modification of production patterns. If town A is to buy goods from other towns, it must either not produce some goods it imports, or produce them in smaller quantities than it consumes. The process by means of which the relocation of production takes place involves, I believe, wages and rents, i.e.,

factor remunerations in general. Rents and wages would rise in town A through a balance of payments mechanism essentially familiar through the discussion of the gold standard. Normally,[12] rising wages imply falling rents and vice versa. The theoretical paradox that both wages and rents in fact rise simultaneously (relatively to outlying districts) is solved by specialization, i.e., by retaining in city A only those goods and services capable of paying both high wages and rents while pushing into smaller towns and more outlying districts low wage-low rent goods and services.

This is a well-documented phenomenon. Industry is moving out of central districts into suburbs; and large cities are becoming more and more service centers while smaller towns are still gaining industry, not only absolutely but relatively. It is also a well known phenomenon that wages tend to vary with size of place, but, though known, it has not been properly understood that distance from a central place is, next to size itself, a second important variable explaining the variation in the general level of wages. Towns of the same size are apt to have higher wages the nearer they are to a big central city.

This process of redistributing population and production made smooth when population and production are growing, and probably made exceedingly difficult when both are stagnant and when population is big to start with, can go so far that we may end with areas, such as the Ruhr or the Atlantic Seaboard from Boston to Washington, in which an underlying structure is hardly visible. Such an area, though giving the impression of an undifferentiated mess, really owes its origin to extreme differentiation and specialization of production and of function.

This is not the place to develop the relevance of what has been said to the recent discussion on international wage equalities, to which it is obviously intimately related. Two consequences can, however, be drawn from it as to the role and origin of cities in developed and underdeveloped countries.

First, though the earlier conclusion that cities of the same size may have quite different economic functions is reinforced, and though from this standpoint theory seems to have introduced more chaos than order, statistical approaches to the problem of size distribution of cities in the manner of Vining's paper become more feasible. The Pareto distribution of population is observed to fit the better the more economic factors have played a role in the formation of towns; more in the United States or Germany than in France, to say nothing of China, Burma, or Indonesia. Basically, it will be remembered that the distribution of towns and of production has been found to be due to the assumption that every consumer is within the market area of every good, an assumption manifestly less true in Burma than in the United States, and even less true in France than in the United States. The less good fit of the Pareto curve in less highly developed countries confirms the relevance of the approach outlined.

Secondly, a pattern of wages and rents emerges in developed countries which does not lead to wage equalities everywhere -- neither of money nor of

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(12) It would be pedantic to state the precise conditions in this context. But it should perhaps be added that (a) appearances to the contrary, I have the marginal productivity theory in mind and not the Ricardian theory of rent; and that (b) I am talking about an equilibrium proposition, i.e., about processes of adaptation, not processes of development.

real wages, however defined -- but which has a pattern nevertheless. A map of wage mountains and valleys in a developed country should show (and does show in the United States as far as data are available) a hilly country with peaks in the big cities more or less gently sloping away from it until the influence of another town is felt. The underdeveloped pattern, on the other hand, with its city without relation to the hinterland narcissistically trading with itself, is apt to reveal a sugar cone-like peak in the city with steep slopes in all directions, hardly ever interrupted by rising slopes.

Again the important social factors required to change the underdeveloped into a developed pattern are outside my competence as well as my frame of reference. When they are favorable, however, the process of urbanization outside the big city needed to absorb excess labor from the country and to make agriculture more efficient, needed also to make better use of the available land as well as of the available labor, and made possible through better means of communication both in a physical and in a social sense, will come about through changing wage and rent patterns. It must eventually bring about a more even pattern of production and with it a standard of living more evenly distributed over the area.

Needless to say, even in the most developed country like the United States, the discussion describes processes continuously under way. However, the discussion, it is hoped, has made a small contribution to the question why and how cities arise in developed areas; why the processes are different in developed and underdeveloped regions; and why cities are so often felt to be "parasitic" in underdeveloped areas.

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A DESCRIPTION OF CERTAIN SPATIAL ASPECTS OF AN ECONOMIC SYSTEM*

The objective of these paragraphs is to render as concretely as I can a concept of spatial structure that does not involve in an essential way the idea of bounded economic regions. Part I has to do with the structure as it may be observed at a point in time. In Part II the nature of the process of development of this structure is considered, and there is included a discussion of the task of finding an analytical explanation of the form and pattern in terms of which the structure is described.

I

1. I wish first to present a visualization of what it is that I think we are attempting to describe. Let us regard the family, or the income spending unit as defined in recent studies of personal income and expediture, as the elementary decision-making unit within the population system. We raise the question of how these units within the United States are distributed over the area of the country.

We may think of a map of the area of the United States divided into sub-areas smaller than counties -- say, ten miles square. Now suppose that each of our units were represented by something like a poker chip, and consider what this map would look like if in each sub-area we were to place in a stack the chips corresponding to the units located in that sub-area.

The distribution of chips would represent a configuration of densities. Just as an ordinary frequency histogram shows the densities over the designated intervals of the range of a variable, the heights of the stacks of chips would show the densities of individuals for the designated sub-areas in two-dimensional space. That is, for any arbitrarily determined origin and co-ordinate axes, the columns of chips would describe a two-dimensional frequency histogram, each sub-area being located as a neighborhood about a point in space and having associated with it some frequency.

2. In looking at the map, we would of course see great discrepancies among the heights of the chips for the various areas. Each area or group of areas containing a city would show up on the map as the location of a density peak. One of these peaks would be seen to tower above all others. Then there would be several scattered over the area which, although half or less as high as the tallest, yet tower over all the immediately surrounding peaks. Scattered about these would be lesser peaks, and about each of these lesser peaks there would be peaks of still lesser heights. Most of the sub-areas would contain no chips or only a few and would represent areas in which no towns are located. A large number of the areas would each contain a relatively small number of chips, each such area representing the location of a village or small

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town. A small number of areas would each contain a relatively large number of chips, these areas representing the locations of sizeable cities.

That is, corresponding to any specified height of stack there would be some definite number of sub-areas whose stacks are of the height specified. For each height there is a frequency of sub-areas, and there is a curious empirical rule which appears to describe, at least for the taller stacks, the relationship between height and frequency. On the assumption that the number of our chips within a sub-area is proportional to the population of the city within that area, the height of the second tallest stack would be approximately one-half the height of the tallest; that of the third tallest approximately one-third the height of the tallest; that of the fiftieth tallest about one-fiftieth of the tallest; and so on. This is the so-called rank-size rule and is expressed by $S_R = S_1/R$, where S_1 is the size of the largest city (height of tallest stack), R the rank in size of a given city, and S_R the size of a city having rank R. With rank expressed as a function of size, this relation is of the form of a cumulative "greater-than" frequency distribution of cities classified by size.[1]

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(1) This is the Pareto cumulative greater-than frequency distribution applied to the description of the sizes of cities. This size distribution is said to hold for any developed system of cities. Remarks will be made below in regard to the idea of a "system of cities." More generally, this distribution is $R = AS^{-\alpha}$, A and α being the parameters of the distribution. In the above statement, $A = S_1$, and $\alpha = 1$.

So far as I know, attention was first drawn to this form of the size distribution of cities by Felix Auerbach, "Das Gesetz der Bevolkerungskonzentration," Petermann's Mitt., Vol. 59, 1913. R. Gibrat, in his Les Inégalités Economiques (Paris, 1931), friefly discussed the distribution and compared it with his own modification of the logarithmic normal distribution. H. W. Singer used the relationship in a discussion of a proposed definition of a measure of degree of urbanization, "Courbes des Populations: A Parallel to Pareto's Law," Economic Journal, 1936, pp. 254-263, and he presented data from a number of countries illustrating conformance to the rule. More recently the late G. K. Zipf, in his Human Behavior and the Principle of Least Effort (Cambridge, Mass., 1949), and J. Q. Stewart, in his "Empirical Mathematical Rules Concerning the Distribution and Equilibrium of Population," The Geographical Review, XXXVII, No. 3 (July, 1947), have placed great emphasis upon this rank-size rule in their discussions of statistical regularities observable in social phenomena.

I am familiar with only one analytical discussion of a process leading to this Pareto distribution. G. U. Yule, in his "A Mathematical Theory of Evolution," Philosophical Transactions of the Royal Society, London, Series B, Vol. 213 (1924), pp. 21-87, developed a probability model in a discussion of the expected proportion of genera that contain exactly r species, and this expected proportion turned out to be given approximately by a Pareto distribution if r is large and if the time elapsed in the process is long.

Table 1

POPULATION OF URBANIZED AREAS (PRELIMINARY COUNT, APRIL 1, 1950) ARRAYED ACCORDING TO SIZE

Urbanized Area	Population	Rank (Apr.1, 1950	Urbanized Area	Population	Rank (Apr.1, 1950
Total	68,787,978				
New York-Northeastern N.J.	12,222,963	1	Springfield-Holyoke, Mass.	356,471	37
Chicago, Ill.	4,902,801	2	Norfolk-Portsmouth, Va.	351,342	38
Los Angeles, Cal.	3,970,595	3	Dayton, Ohio	343,781	39
Philadelphia, Pa.	2,913,516	4	Fort Worth, Texas	313,872	40
Detroit, Mich.	2,644,476	5	Omaha, Neb.	306,291	41
Boston, Mass.	2,218,893	6	Hartford, Conn.	299,676	42
San Francisco-Oakland, Cal.	1,997,303	7	Youngstown, Ohio	297,084	43
Pittsburgh, Pa.	1,525,966	8	Albany-Troy, N.Y.	290,209	44
St. Louis, Mo.	1,394,051	9	Oklahoma City, Okla.	273,424	45
Cleveland, Ohio	1,372,274	10	Wilkes-Barre, Pa.	270,978	46
Washington, D.C.	1,281,572	11	Syracuse, N.Y.	264,610	47
Baltimore, Md.	1,151,050	12	Nashville, Tenn.	257,898	48
Minneapolis-St. Paul, Minn.	977,931	13	Richmond, Va.	257,423	49
Milwaukee, Wis.	823,430	14	New Haven, Conn.	242,589	50
Cincinnati, Ohio	808,021	15	Jacksonville, Fla.	241,579	51
Buffalo, N.Y.	794,747	16	Bridgeport, Conn.	237,954	52
Houston, Texas	697,287	17	Scranton, Pa.	235,122	53
Kansas City, Mo.	689,350	18	Salt Lake City, Utah	226,880	54
New Orleans, La.	655,822	19	Grand Rapids, Mich.	225,427	55
Seattle, Wash.	616,047	20	Allentown-Bethlehem, Pa.	225,155	56
Providence, R.I.	581,607	21	Worcester, Mass.	217,705	57
Dallas, Texas	536,864	22	Phoenix, Ariz.	214,335	58
Portland, Ore.	509,120	23	Sacramento, Cal.	210,081	59
Atlanta, Ga.	502,204	24	Tulsa, Okla.	203,968	60
Indianapolis, Ind.	499,799	25	Des Moines, Iowa	198,892	61
Denver, Col.	495,513	26	Flint, Mich.	197,151	62
Louisville, Ky.	470,394	27	Davenport, Iowa-Rock Island-Moline, Ill.	193,733	63
Miami, Fla.	453,004	28	Wichita, Kan.	192,009	64
San Antonio, Texas	447,365	29	Trenton, N.J.	189,276	65
Birmingham, Ala.	438,726	30	Wilmington, Del.	186,265	66
Columbus, Ohio	436,257	31	Mobile, Ala.	180,892	67
San Diego, Cal.	413,274	32	Tampa, Fla.	178,398	68
Rochester, N.Y.	406,923	33	San Jose, Cal.	175,983	69
Memphis, Tenn.	404,033	34	Spokane, Wash.	174,853	70
Akron, Ohio	365,130	35			
Toledo, Ohio	361,493	36			

Table 1 (continued)

Urbanized Area	Population	Rank (Apr.1, 1950)	Urbanized Area	Population	Rank (Apr.1, 1950)
Canton, Ohio	173,215	71	Lawrence, Mass.	111,937	111
Stamford-Norwalk, Conn.	172,197	72	Madison, Wis.	109,577	112
Harrisburg, Pa.	168,933	73	Montgomery, Ala.	108,034	113
South Bend, Ind.	167,879	74	Wheeling, W. Va.	106,151	114
Chattanooga, Tenn.	167,031	75	Roanoke, Va.	105,883	115
Tacoma, Wash.	166,910	76	Lowell, Mass.	105,783	116
Huntington, W.Va.-			Saginaw, Mich.	105,358	117
Ashland, Ky.	156,136	77	Atlantic City, N.J.	105,326	118
Reading, Pa.	154,571	78	Jackson, Miss.	99,677	119
Peoria, Ill.	154,084	79	Lincoln, Neb.	98,048	120
Erie, Pa.	151,282	80	Niagara Falls, N.Y.	97,648	121
Little Rock-N.			Springfield, Ill.	96,649	122
Little Rock, Ark.	150,758	81	Beaumont, Texas	93,746	123
Shreveport, La.	148,296	82	Macon, Ga.	93,305	124
Knoxville, Tenn.	148,174	83	Johnstown, Pa.	92,780	125
Binghamton, N.Y.	144,570	84	Waco, Texas	92,299	126
Duluth, Minn.-			Brockton, Mass.	92,086	127
Superior, Wis.	142,344	85	Pontiac, Mich.	91,799	128
Charlotte, N.C.	140,085	86	Winston-Salem, N.C.	91,493	129
Fort Wayne, Ind.	139,529	87	Sioux City, Iowa	90,144	130
Baton Rouge, La.	137,108	88	Topeka, Kan.	88,100	131
El Paso, Texas	136,430	89	Augusta, Ga.	87,823	132
Austin, Texas	135,465	90	Altoona, Pa.	86,249	133
San Bernadino, Cal.	135,394	91	Muskegon, Mich.	84,775	134
Lansing, Mich.	133,625	92	Manchester, N.H.	84,768	135
Evansville, Ind.	133,200	93	Waterloo, Iowa	83,551	136
Waterbury, Conn.	131,442	94	Kalamazoo, Mich.	82,859	137
Charleston, W.Va.	130,122	95	Greensboro, N.C.	82,719	138
Fresno, Cal.	129,275	96	Springfield, Ohio	81,837	139
Savannah, Ga.	128,190	97	Port Arthur, Texas	81,763	140
New Bedford, Mass.	125,354	98	St. Joseph, Mo.	79,280	141
Schenectady, N.Y.	123,573	99	York, Pa.	78,495	142
New Britain-			Cedar Rapids, Iowa	77,990	143
Bristol, Conn.	122,618	100	Terre Haute, Ind.	77,845	144
Corpus Christi,Tex.	122,354	101	Racine, Wis.	76,101	145
Rockford, Ill.	121,723	102	Lancaster, Pa.	76,087	146
Columbia, S.C.	119,747	103	Decatur, Ill.	75,148	147
Columbus, Ga.	118,122	104	Springfield, Mo.	75,117	148
Fall River, Mass.	117,881	105	Amarillo, Texas	73,935	149
Utica, N.Y.	117,390	106	Pueblo, Colo.	73,102	150
Charleston, S.C.	116,441	107	Orlando, Fla.	75,572	151
St.Petersburg,Fla.	113,378	108	Durham, N.C.	72,369	152
Stockton, Cal.	113,362	109	Galveston, Texas	71,000	153
Portland, Me.	112,659	110	Raleigh, N.C.	68,190	154
			Hamilton, Ohio	63,021	155

Table 1 (continued)

Urbanized Area	Population	Rank (Apr.1, 1950)	Urbanized Area	Population	Rank (Apr.1, 1950)
Ashville, N.C.	57,658	156	Fort Smith, Ark.	55,947	157

Source: Indication of the sources of tables and charts in this paper and acknowledgements for permission to publish them will be found in the Appendix to this paper, page 196.

Table 1 and Figure 1 show this kind of arrangement of the populations of the larger urban communities of the United States. One may easily check the conformance of this array of sizes with the relationship described by the above formula. For example, the tenth highest stack on our map would represent Cleveland, and it would be approximately one-tenth as high as the highest, representing New York. The twentieth highest (Seattle) would be approximately one-half the height of the tenth highest. The fortieth highest (Fort Worth) would be approximately one-half the height of the twentieth. The eightieth highest (Erie) would be about one-half the height of the fortieth. These cities whose ranks are around 100 (Schenectady, New Britain-Bristol, Corpus Christi, Rockford) are about one-half the size of those cities whose ranks are around 50 (Richmond, New Haven, Jacksonville).

This, then, is one element of pattern that would be observed among the stacks of chips on the map: there apparently is some numerical order among the heights of the many density peaks that would be seen upon the map. A study of census data indicates a stability in the form of this numerical order. Since 1790, when such information was first made available, the size distribution described above has maintained a fairly stable form. As population has increased and as individuals have made their moves from place to place over the country, some cities have grown rapidly, others have grown slowly or not at all, and others have become smaller or even disappeared. This is illustrated in Figure 2, which has been taken from a work by Carl H. Madden.[2] The figure shows for each of the 17 censuses an arrangement of data similar to that presented in Figure 1, and in addition the respective positions of four selected cities are indicated in order to illustrate divergencies of growth rates of individual cities. During this 160-year period the population of the nation has grown many-fold. Some of the older cities have grown with the system in such a way as to maintain approximately their respective positions in the array of city sizes. Some of the towns which formed in the newly settled areas have grown phenomenally, while others failed to catch on in this way. But with all this development and divergency of growth of individual cities, the maps that we

(2) Madden, Carl H., "Figures and Charts for 'Some indications of Stability in the Growth of Cities,'" presented at the Annual Meeting of the Population Association of America, May 9, 1954.

Figure 1

POPULATION OF URBANIZED AREAS RANKED BY SIZE, 1950

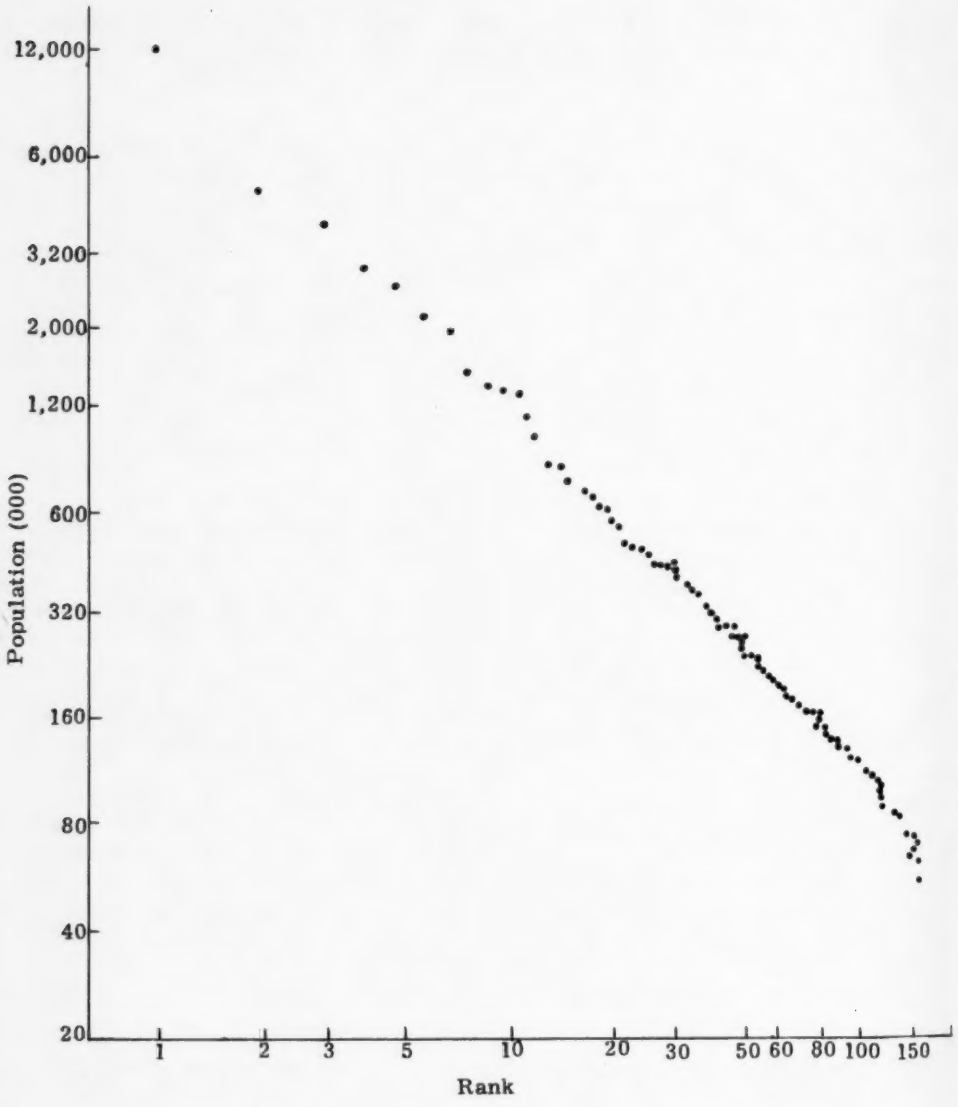
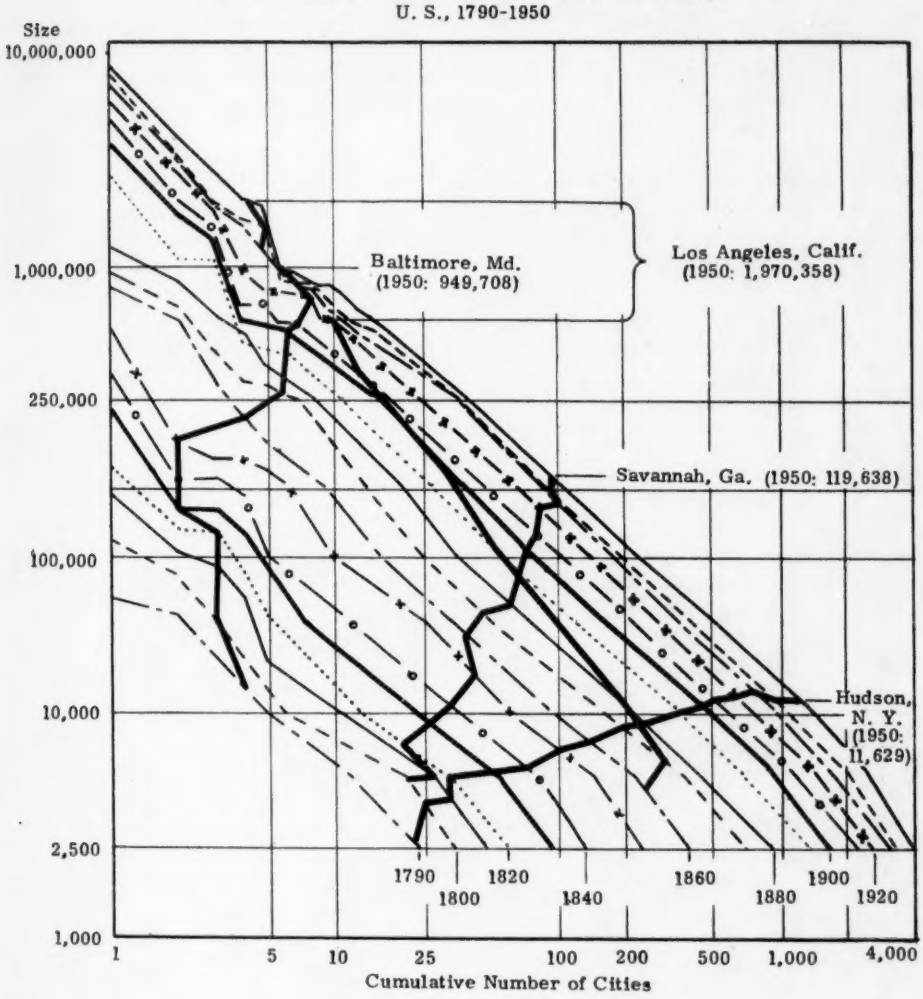


Figure 2

CHANGE IN RANK OF FOUR SELECTED CITIES IN RANKING OF CUMULATIVE NUMBER OF PLACES BY SIZE, U. S., 1790-1950



might construct from census data for the different decades would each show stacks of chips whose heights approximately conform to the same numerical rule of order.

3. The above paragraphs refer to the numerical relationships among the heights of the stacks shown on the map. We now consider the spatial orientation of these different sized stacks.

D. J. Bogue, in his studies of population, has designated 67 cities within the United States as metropolitan centers.[3] To each of these centers he has assigned a hinterland area, and the population organization within the hinterland area and including the center he terms a metropolitan community. The country is thus divided into some 67 parts.

The following cities are the metropolitan centers of the 67 metropolitan communities which he designates, and alongside these are placed the cities that are not listed by Bogue as centers but which are larger than some of those that he does include.

The 67 Metropolitan Centers Listed by Bogue		Urban Centers Not Included Among Bogue's Centers but Larger Than Some Included	
Rank in Size in Nation	Name of Center	Rank in Size in Nation	Name of Center
1	New York, N.Y.		
2	Chicago, Ill.		
3	Los Angeles, Calif.		
4	Philadelphia, Pa.		
5	Detroit, Mich.		
6	Boston, Mass.		
7	San Francisco, Calif.		
8	Pittsburgh, Pa.		
9	St. Louis, Mo.		
10	Cleveland, Ohio		
11	Washington, D.C.		
12	Baltimore, Md.		
13	Minneapolis-St.Paul, Minn.		
14	Milwaukee, Wis.		
15	Cincinnati, Ohio		
16	Buffalo, New York		
17	Houston, Texas		
18	Kansas City, Mo.		
19	New Orleans, La.		
20	Seattle, Wash.		
21	Providence, R. I.		

(3) Bogue, D. J., The Structure of the Metropolitan Community - A Study of Dominance and Subdominace (Ann Arbor: University of Michigan, 1950).

The 67 Metropolitan Centers Listed by Bogue		Urban Centers Not Included Among Bogue's Centers but Larger Than Some Included	
Rank in Size in Nation	Name of Center	Rank in Size in Nation	Name of Center
22	Dallas, Texas		
23	Portland, Ore.		
24	Atlanta, Ga.		
25	Indianapolis, Ind.		
26	Denver, Colo.		
27	Louisville, Ky.		
28	Miami, Fla.		
29	San Antonio, Texas		
30	Birmingham, Ala.		
31	Columbus, Ohio		
32	San Diego, Calif.		
33	Rochester, N. Y.		
34	Memphis, Tenn.		
		(35)	(Akron, Ohio)
36	Toledo, Ohio		
37	Springfield-Holyoke, Mass.		
38	Norfolk-Portsmouth, Va.		
39	Dayton, Ohio		
40	Fort Worth, Texas		
41	Omaha, Neb.		
42	Hartford, Conn.		
		(43)	(Youngstown, Ohio)
44	Albany-Troy, N. Y.		
45	Oklahoma City, Okla.		
		(46)	(Wilkes-Barre, Pa.
47	Syracuse, N. Y.		
48	Nashville, Tenn.		
49	Richmond, Va.		
		(50)	(New Haven, Conn.)
51	Jacksonville, Fla.		
		(52)	(Bridgeport, Conn.)
53	Scranton, Pa.		
54	Salt Lake City, Utah		
55	Grand Rapids, Mich.		
		(56)	(Allentown-Bethlehem, Pa.)
		(57)	(Worcester, Mass.)
		(58)	(Phoenix, Ariz.)
59	Sacramento, Calif.		
60	Tulsa, Okla.		
61	Des Moines, Iowa		
		(62)	(Flint, Mich.)
63	Davenport, Iowa-Rock Island-Moline, Ill.		

The 67 Metropolitan Centers Listed by Bogue		Urban Centers Not Included Among Bogue's Centers but Larger Than Some Included	
Rank in Size in Nation	Name of Center	Rank in Size in Nation	Name of Center
64	Wichita, Kansas		
		(65)	(Trenton, N.J.)
		(66)	(Wilmington, Del.)
		(67)	(Mobile, Ala.)
68	Tampa, Fla.		
		(69)	(San Jose, Calif.)
70	Spokane, Wash.		
		(71)	(Canton, Ohio)
		(72)	(Stamford-Norwalk, Conn.
		(73)	(Harrisburg, Pa.)
74	South Bend, Ind.		
75	Chattanooga, Tenn.		
		(76)	(Tacoma, Wash.)
		(77)	(Huntington, W. Va.-Ashland, Ky.)
		(78)	(Reading, Pa.)
79	Peoria, Ill.		
80	Erie, Pa.		
		(81)	(Little Rock-North Little Rock, Ark.)
		(82)	(Shreveport, La.)
83	Knoxville, Tenn.		
		(84)	(Binghamton, N. Y.)
85	Duluth, Minn.-Superior, Wis.		
86	Charlotte, N.C.		
87	Fort Wayne, Ind.		
		(88)	(Baton Rouge, La.)
89	El Paso, Texas		
		(90)	(Austin, Texas)
		(91)	(San Bernadino, Calif.)
		(92)	(Lansing, Mich.)
93	Evansville, Ind.		

The first 10 centers, represented on the map by the 10 tallest stacks, account for 8 different states: located in New England, the Middle Atlantic, the Great Lakes Region, the Middle West, and the Far West. The towering stack is at New York, and the two next in height, a half or less as high, are placed in the North Central and Far Western parts of the country. The stack at Philadelphia is only a fourth as high as that at New York, and the one at Pittsburgh only half as high as the one at Philadelphia. At St. Louis the stack is less than a third as high as that at Chicago.

The next 10 centers account for 6 additional states: in the North Central Area, the North Far West, the Great Plains, the Southwest, and the South at New Orleans. But the stacks representing these centers are of course becoming smaller in height. The peaks at Baltimore and Washington are only about a third as high as that at Philadelphia; those at Milwaukee and Minneapolis about one-sixth as high as that at Chicago; those at Kansas City, Houston, New Orleans, and Seattle about a half as high as those at St. Louis, Cleveland, and Washington.

The next 10 centers account for 8 additional states and bring in the Southeast, with Louisville, Atlanta, Birmingham, and Miami, and the Rocky Mountain region, with Denver. The heights of the stacks representing these cities are about one-tenth that at Chicago and about one-half those at St. Louis and Washington.

The first thirty centers are thus scattered over the entire national area. The rest of the 67 centers listed by Bogue are interspersed among the larger 30, and in all there are thirty-one different states accounted for. It may be noted that the smaller centers included on the list -- Knoxville, Duluth, Charlotte, Fort Wayne, El Paso, and Evansville -- would be represented by stacks whose heights are only about one-ninetieth the height of the tallest stack on the map and only about one-tenth the height of that representing St. Louis. But Bogue assigns to each of the centers a surrounding hinterland area with no overlapping and with the entire area of the nation accounted for.

The sixteen states for which there are no listed centers are as follows:

Maine	Arkansas	Arizona	Idaho
New Hampshire	Mississippi	New Mexico	Nevada
Vermont	South Carolina	Wyoming	South Dakota
New Jersey	West Virginia	Montana	North Dakota

Upon our map, some of these states -- viz., Arkansas, Arizona, West Virginia, New Jersey, and Delaware -- would contain stacks of chips considerably taller than many representing cities listed as centers. A number of the others -- South Carolina, Mississippi, Maine, New Mexico -- would contain stacks not noticeably smaller in height than some representing cities designated as metropolitan centers. But the stacks in these states would be low compared with stacks in nearby states, and the areas contained in these states are classed by Bogue as outlying hinterland areas and parts of organizations of population the central places of which lie more or less at a distance.

Moreover, there are many other peaks with heights larger than those of some centers but which are not listed as centers. Some of these are overshadowed by nearby stacks -- e.g., Akron would be represented by a stack twice the height of those of Wichita, South Bend, or Spokane, but it is close to that of Cleveland and only one-third as high. But some do not seem so close to the nearest taller peaks -- e.g., Mobile, Shreveport, Austin. And there are many more peaks which are not much smaller than those included as centers but which stand out within the areas in which they are placed.

Figure 3

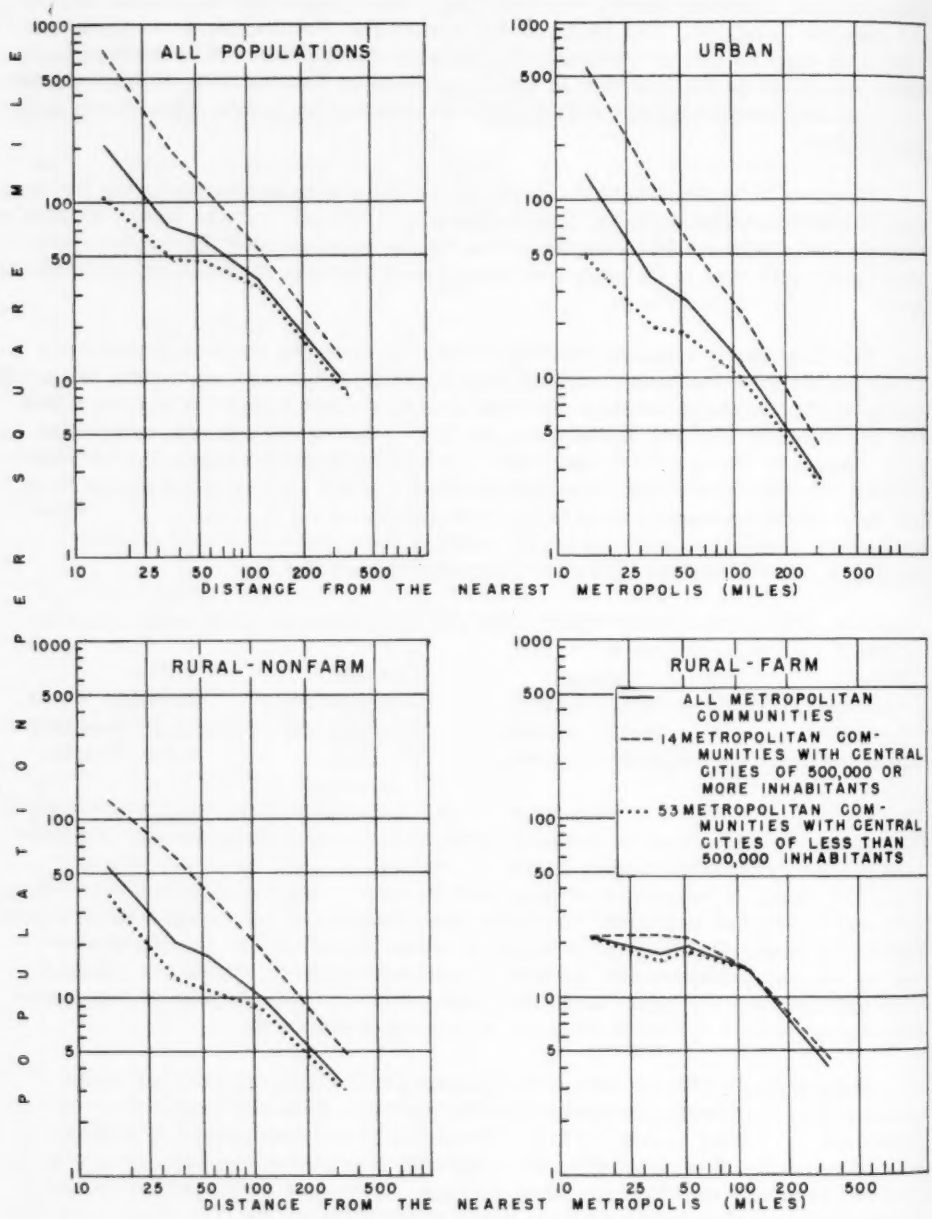


CHART 3 URBAN AND RURAL POPULATION PER SQUARE MILE OF HINTERLAND BY DISTANCE FROM THE NEAREST METROPOLIS AND SIZE CLASS OF THE METROPOLIS. UNITED STATES, 1940

Admittedly, the rule by which the centers were designated is arbitrary, and other persons working independently might well have adopted other rules yielding longer lists of centers. Indeed, any cutting-off place at all in the selection of the centers seems arbitrary, as does the assignment of the same type of hinterland to an El Paso or Evansville or Duluth as is assigned to a New York or Chicago. But working with this list, Bogue has described certain features of the organization of population which appear to be not dependent in an essential way upon his conception of a metropolitan community but which indicate in a general way how our stacks are spatially oriented.

Having designated the centers -- which would appear upon the map as the taller stacks -- Bogue assigned each county, and town or city not designated as a center, to some particular center as a part of its "dominion," so to speak. He then established distance zones for each center and classified each county or town in accordance with the distance zone containing it. Then, for comparable distance zones for all the 67 centers, or for certain classes of centers, he divided total population by total land area to obtain a figure representing an average density of population for each distance zone. The following charts demonstrate the falling off of density -- that is, the decline in the heights of the stacks -- as one moves away from central density peaks. Figure 2 shows the relation between density and distance for two classes of centers -- the 14 largest centers and the 53 smaller ones. Figure 3 shows the same relation for a different classification of the same centers -- those respectively in the North East, the North Central, the West, and the South.

Each axis of these charts is logarithmically scaled. The lines are downward sloping, and some are approximately straight. In this respect the visual impression given by these figures is similar to that given by Figure 1 which was also logarithmically scaled and which showed a downward sloping straight line. In the case of Figure 1, the relationship resembles a Pareto cumulative greater-than distribution of cities classified by size. This may be readily converted into a frequency distribution of cities showing the number of cities for each size class. In Figure 2 the resemblance is with the relationship, $Y = Ad^{-a}$, where Y is the number of persons per unit area (square mile), d the distance from center, and A and a are parameters.

This relationship may be expressed so as to give the number of persons living d miles from the metropolitan center. The number of unit areas lying d units of distance from the center is approximately $2\pi d$. Multiplying this by the number of persons per unit area at that distance yields the number of persons living at that distance, and this too would be of the Pareto form:

$$\text{Number of persons} = 2\pi Ad^{-a+1}$$

Or, alternatively, we may express the relation shown in Figure 2 as $d = BY^{-b}$. That is, knowing the density of the unit area, we may calculate from this relationship its distance from the center. Now the number of places at distance d is, again, approximately $2\pi d$. But d is given by the above relation, and thus,

$$\text{Number of Places} = 2\pi d = 2\pi BY^{-b}$$

This represents a frequency distribution showing the number of unit areas containing Y individuals. The relationship shown in Figure 1 is similar to this.

The rank-size rule has reference only to those unit areas containing a city or town, but for this set of areas it implies a relation having the above form and giving the number of such unit areas containing Y individuals.

These figures then describe certain attributes of pattern to be observed in the spatial distribution of a human population. There are enormous concentrations of family units at various places; and the sizes of these clusters which we know as cities are apparently interdependent, there being a rule which indicates the approximate number of clusters that are as large as the size of any one of them which we may designate. These clusters seem to be formed into a sort of system (or, from the point of view of our map with its stacks of chips, a configuration of densities) in which large clusters are spaced over the area, the smaller concentrations being interspersed among the larger and in such a way that, for an area surrounding each of the major centers, density of population declines systematically as one moves out from the center.

4. From this view, the population system within the United States, or within any large populated area, appears as an interconnected system of centers. The connections are observed in the transport routes along which goods and communications flow. In moving along the connecting lines between major centers, one observes the density of population rising to and falling from smaller peaks. From each major center, lines extend to such smaller centers. These lower order centers have lines of communication and transport extending out to yet smaller centers. That which may appear as a principal central place from the point of view of a given set of centers may appear as a subsidiary central place from the point of view of a larger set of centers. In this sense, the centers would form a hierarchy of central places. This is an idea associated with the work of Walter Christaller,[4] and it would seem to add something to the conceptual scheme employed by Bogue.

Christaller conceives of goods and services as being divided into two classes. On the one hand there are dispersed goods, the productions of which are directly connected with the locations of natural resources. The extractive industries -- farming, mining, et cetera -- yield such goods. On the other hand, there are central goods and services the productions of which involve an assemblage of goods whose productions are geographically dispersed. The central goods and services are then sub-classified. It is supposed that a necessary condition for the existence of an economic activity yielding a particular central product or service is the existence of some minimum number of consuming units within some given range of the site of that activity. Central goods and services are regarded as characterized by this minimum number and range and as classifiable in these terms. In such a classification, the lower orders of central goods are those having small ranges and small minimum numbers of consuming units, and the order of a central good increases with an increase of these numbers.

Christaller's system of central places is a system of places at which these central goods of the various types are made available. He designates nine classes of central places as follows:

---

(4) Die Zentralen Orte in Süddeutschland, Jena, 1933.

M-place	--	Marktflecken
A-place	--	Amtsstädtchen
K-place	--	Kreisstädtchen
B-place	--	Bezirkshauptorte
G-place	--	Gaubezirk
P-place	--	Provinzialhauptorte
L-place	--	Landeszentralen
RT-place	--	Reichsteilstädte
R-place	--	Reichshauptstädte

The formal conception of a system of places is represented by a system of different types of points in a plane. As a geometric pattern, his system of points may be constructed as follows: Begin by placing dots upon a sheet of paper in such a way that all pairs of adjacent dots are equi-distant. Each dot would form a corner of an equilateral triangle that possibly could be formed by connecting adjacent dots. The sheet would be filled with such dots, thus,

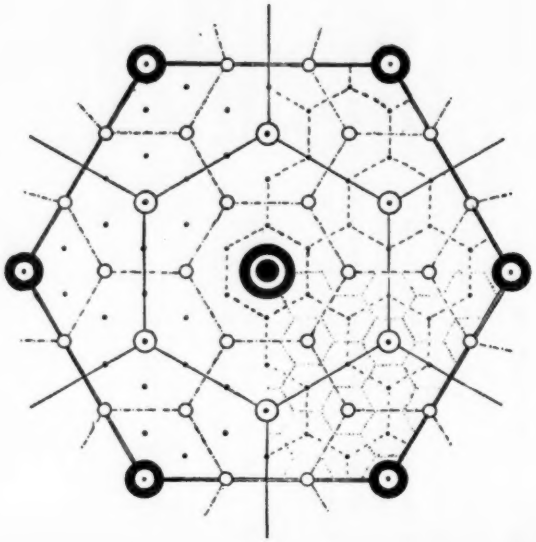
These dots represent distributing centers for the lowest order of central goods and services, the M-type central goods. The distance between the adjacent dots is twice the range of this lowest order of central good.

As a second step, mark with a small circle a dot in the middle part of the sheet and likewise each other dot that constitutes a corner of a next larger sized equilateral triangle having an uncircled dot at its center. The above dots will then look like the following:

ECONOMIC DEVELOPMENT AND CULTURAL CHANGE

Figure 4

HEXAGONAL AND CIRCULAR SCHEMA
OF CHRISTALLER'S SYSTEM OF CENTRAL CITIES



G-Place
B-Place
K-Place
A-Place
M-Place

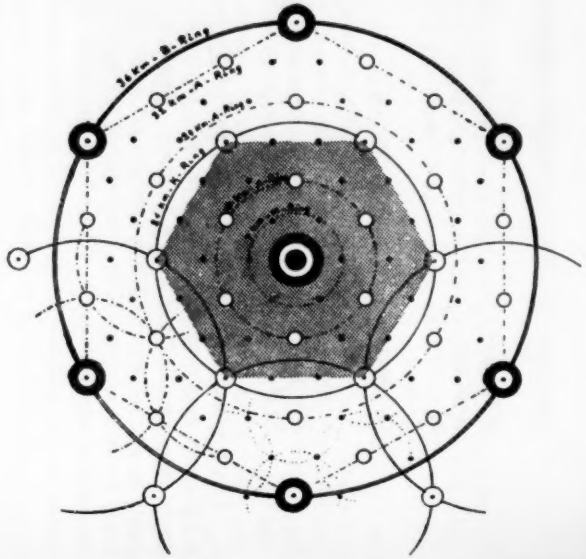
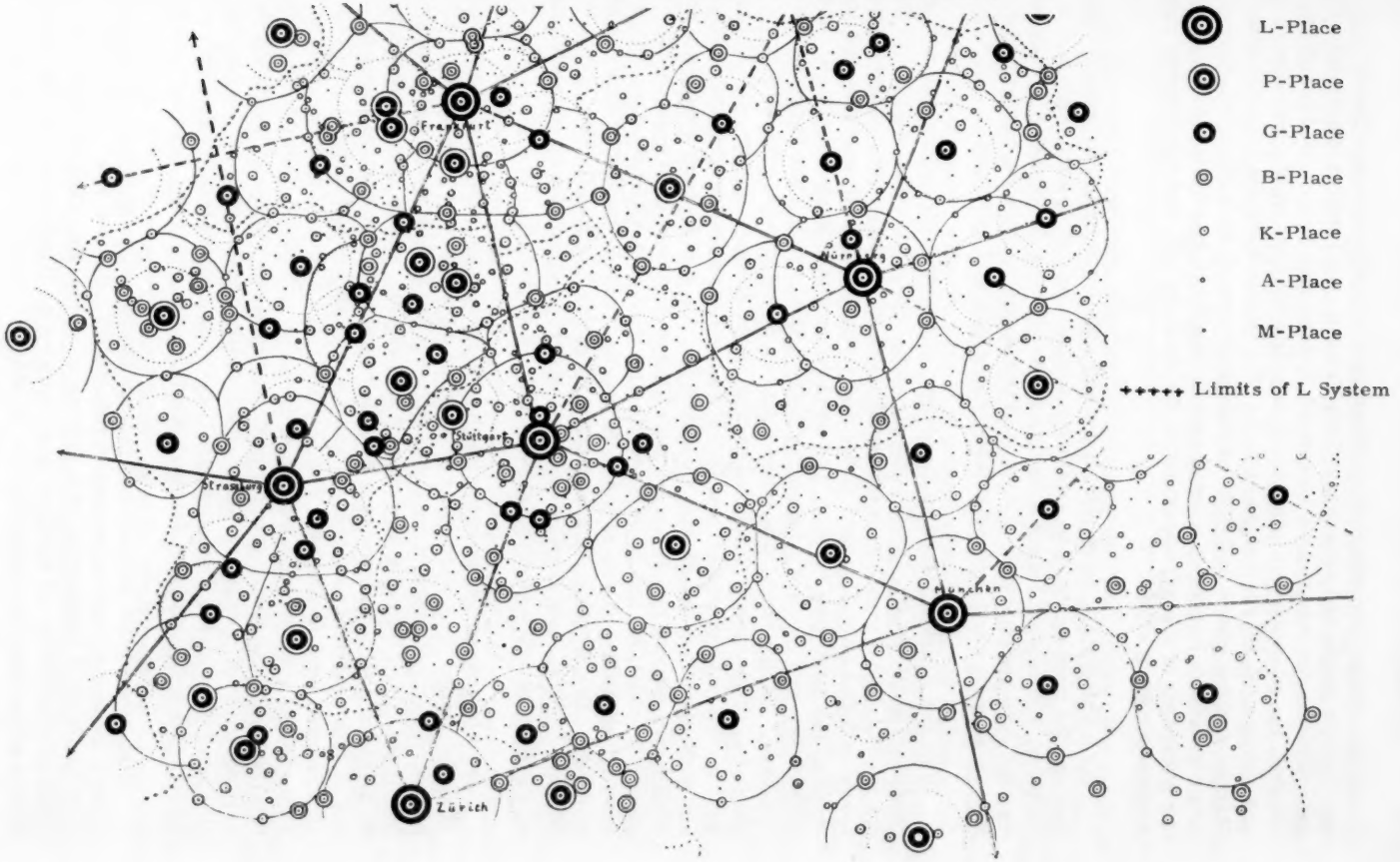


Figure 5

A SYSTEM OF CENTRAL CITIES IN SOUTHERN GERMANY



From the places represented by these circled dots are distributed both M-type and A-type goods and services. This second step implies a definite relationship between the respective ranges of M-type and A-type central goods and between the respective distances separating sources of M-type central goods and sources of A-type central goods. If $\underline{a}$ be the distance between sources of M-type central goods and $a/2$ the market range of M-type goods, then the distance between sources of A-type central goods is given, in accordance with the geometry of the arrangement of the dots, by $a\sqrt{3}$, and the market range of A-type goods is $a/2\sqrt{3}$.

As a third step, mark with a second small circle the originally marked central dot once again, and similarly circle those A-places that will form the smallest equilateral triangle having an A-place at its center. The double-circled dots represent K-places, and these central places are sources of K-type as well as of A-type and M-type goods and services.

For the illustration of an L-system of points, this procedure would be continued until the B-, the G-, the P-, and the L-type places are located on the sheet. The L-system is centered upon an L-place and consists of all the lower ordered points ranged about this L-place. The P-systems are the systems of the next lower order, and each is centered upon a P-place. In succession, there are the G-systems, the B-systems, the K-systems, and the A-systems. Each central place has its area of reference. The B-place, for example, is the center for the distribution of K-type, A-type, and M-type as well as the B-type central goods. Within its area reference, there are a number of K-places in which are available K-, A-, and M-type goods and services. Within the area of reference of one of these K-places there are a number of places in which A- and M-type goods are available. And finally, within the area of reference of one of these A-places there is available only the M-type of goods. The L-place is a dispersal point for L-, P-, G-, B-, K-, A-, and M-type of goods and services. In using these terms, we conceive of each type of good as having a characteristic range of dispersal.

In this conceptual scheme, each type of central place has its complement of other types. The particular geometric arrangement presented by Christaller has each central place of an order higher than the M-place wreathed by 6 M-places, each forming a corner of a hexagon. These M-places are $\underline{a}$ units of distance apart, and are at a distance of $\underline{a}$ from the central place at the center of this smallest hexagon. Each place of an order higher than the A-place is wreathed by 6 A-places. The A-places are corners of a next larger sized hexagon and may be seen on this sheet to be $a\sqrt{3}$ units of distance apart. Similarly, the K-places form a next larger sized hexagon and within this arrangement of points are $a(\sqrt{3})^2$ units of distance apart. In the same way, B-places, G-places, P-places, and L-places are respectively $a(\sqrt{3})^3$, $a(\sqrt{3})^4$, $a(\sqrt{3})^5$, and $a(\sqrt{3})^6$ units of distance apart.

I go beyond the purposes of the present discussion when I describe Christaller's geometric arrangement in this detail. For we are concerned here only with the formal conception of a system of cities, and Christaller's particular system of points is of interest to us only as an illustration of this conception. Whereas the idea of a hierarchical system of cities seems to me to be useful in organizing a description of empirical phenomena, I see no basis for regarding

Christaller's particular geometric pattern as corresponding to an observable pattern of distribution of population units. The number of types or classes into which cities are classified and the definitions of these classes are arbitrary. That which Christaller presents as theoretical analysis I am unable to understand as analysis. And his formulation of the problem as an analytical problem of determining a "rational" or "optimum" spatial orientation of cities seems to me to be based upon a fundamental confusion.[5]

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(5) The concept of optimum implies an ordering of alternatives by a mind or will or decision-making agency. In Christaller's case, the alternatives to be ordered are presumably the untold millions of possible combinations of locations of family units. But there is no mind or will as a single decision-making agency which evaluates and orders alternative combinations of locations of the human beings which make up a society. If there were such a power concerned with the choice of a best combination of locations of family units, as chattels of this will, the problem confronting this choosing agency would be formally of the nature of an assignment problem, such as is currently considered in the study of game theory. But there is no power concerned with the choice of a combination of individual locations per se. The legislative agency of a society of free beings, as a choosing agency transcending the individual members of the society, is concerned directly with the problem of choosing a "best" or "optimum" system of laws and institutions which constrain the choices of individuals. Within these constraints imposed by the society of individuals, each individual unit chooses the locations of those things within its power. There are thus millions upon millions of individual choices of locations and not a single choice of a combination of all locations.

There is no choosing agency which directly and primarily selects a combination of all individual locations. But a spatial orientation of human beings results from the free actions of individuals within the constraints of a system of laws and institutions. And the legislative or governmental agency of the society is continually reviewing the existing laws and institutions and continually seeking to improve or reform these constraints upon individual action. In doing this, it relevantly considers the resulting spatial orientation of the members of the society. But it is not directly seeking to minimize some simple-sounding quantity such as "aggregate transport costs," whatever this may mean.

The analytical problem, then, is not that of determining an "optimum" or "economical" spatial orientation of cities. Rather, it is that of analyzing a process implicit in a sequence of individual actions performed within a specified system of constraints. The characteristics of this process are among the relevant features to be considered by the society of individuals in its evaluation, through its legislative agency, of alternative forms which its laws and institutions might take.

I attempt in Part II to illustrate in an elementary way what I conceive to be the nature of such an analysis of a process.

But apart from the details of Christaller's particular pattern, we have a principal interest in his illustrations of the formal conception of a system of cities. The empirical thing which we have before us to describe and interpret is the two dimensional density configuration formed by the columns of chips distributed over our map. Points illustratively placed upon a sheet or map to represent cities correspond to density peaks on this distribution. It is the conception of a hierarchical system of these density peaks which would seem to add to such a description as that presented by Bogue.[6]

5. Bogue adopted a rule which, when applied to census data for 1940, selected out 67 cities and marked off the boundaries of 67 non-overlapping sub-areas into which the entire national area was divided. All the information required for applying his rule would be included on our map with its stacks of chips. The selection of centers was in terms of size (i.e., height of stack) and distance from nearest centers. The determining of the boundaries was done by bisecting the lines drawn between adjacent centers. The 67 tallest stacks to which sizeable hinterlands could be assigned were designated by the same name -- metropolitan center -- and the area assigned to any one of them was looked upon as being of the same character as that assigned to any other. New York's area was bound in by the areas of Philadelphia, Scranton, Albany, and Hartford, and was no different in nature from that of El Paso.

The rule by which these cities were set apart from all the rest and by which the national area was divided into exactly 67 parts is of course arbitrary. Other rules which may appear no less plausible would result in different sets of boundaries. But any particular set of sub-areas, appearing as patches upon our map, is only an expedient for the classification of data and the sub-areas in themselves are not fundamental components of the structure being studied. They are analogous to class intervals that may be used in the construction of a frequency distribution of observations made upon a continuous variable. Such intervals that may be used are expedients for the classification of the data and are not inherent in the nature of the phenomena being described.

Whereas Bogue designates these 67 largest cities by the same name, an observer following Christaller's conceptual scheme would recognize a number of different types of cities among this group. He would find some of these same types among the cities not included among the list of 67, and he would extend his classification by type to include the towns and cities of all sizes. The areas of reference which he would assign to the cities belonging to one type would overlap areas assigned to centers of lesser order. It seems obvious that the drawing of boundaries of sub-areas, overlapping or not, introduces a discreteness into the description which is not inherent in the phenomena being described. No less obvious is it that a classification of cities by type introduces for the sake of expediency a discreteness which is not inherent in the phenomena.

The designation of types of central places, just as the delineation of hinterland boundaries, involves the application of some rule to a set of data. In Christaller's conception, the notion of type of city or central place refers to

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(6) The Structure of the Metropolitan Community, Ann Arbor, Michigan, 1950.

the kinds of activities pursued at the site of the central place. The clustering of persons into a city or town is a clustering of complementing activities, and distinctions among types of places are distinctions among collections of activities. The designation of kinds of activity presents of course another classification problem. A recent study,[7] presenting illustrative material of considerable interest from the point of view of Christaller's conception, is an example of an effort to classify communities by type on the basis of distinctions among collections of activities. For the purpose of considering the nature of the hierarchical arrangement of central places, we shall discuss the procedures followed in this study.

The study deals with the communities of southwestern Wisconsin, an area containing only small towns, some 234 places with the largest of them having about 7000 inhabitants. A preceding figure and table have shown an array of the sizes of the larger cities in the United States. The following figure,[8] taken from Mr. Brush's study, shows an array of the sizes of these small towns constituting the central places of southwest Wisconsin. As in the case of the larger cities, there are no discrete steps evident in the gradation of city size. As one passes from large to small, the observations look as though they might have been made upon a continuous variable.

Notwithstanding the apparent virtual continuity in size, the author maintains that the 234 communities fall naturally into three types of central place: Hamlet; Village; and Town. In classifying the communities by type, he applied the following rule:[9]

1. List all of the settlements within the area under study. A collection of buildings must satisfy the following requirements in order to be regarded as a settlement: (a) It must contain at least five buildings used by human beings for residences, business establishments, or social gatherings, and these must be clustered within a circle with a diameter not greater than one-quarter mile; (b) there must be not less than four residence units at least two of which are non-farm houses; (c) there must be a total of at least six functional units -- residential, business, social, et cetera. Settlements not meeting these minimal requirements are not regarded as communities or central places.

2. Given a set of specifications defining various kinds of establishments, list for each community the kinds of establishments and the number of trade and service agencies found therein.

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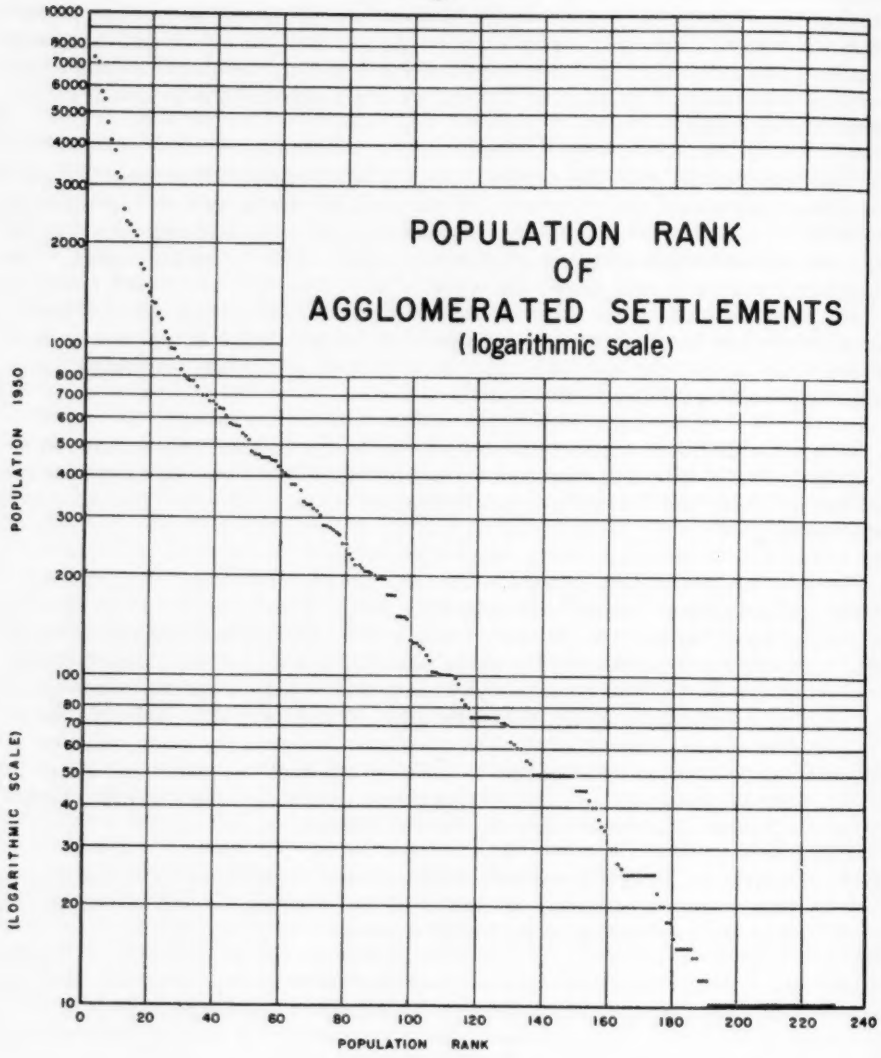
(7) Brush, J. E., "The Hierarchy of Central Places in Southwestern Wisconsin," The Geographical Review, XLIII, No. 3 (1953), pp. 380-402.

(8) It may be noted that the two figures are not scaled the same.

(9) This rule is not explicitly stated by Mr. Brush. On the basis of his description of procedure on pp. 385-390 I have inferred this formulation. In stating the rule in this form I emphasize what appear to be arbitrary features. But in doing so I am not attempting to suggest that there are faults in his procedure that I can remedy. Mr. Brush's article, in my opinion, is a very useful one, and my intention is to use it in a further inquiry into the nature of the phenomena which he describes.

Figure 6


POPULATION RANK
OF
AGGLOMERATED SETTLEMENTS
(logarithmic scale)
POPULATION 1950
(LOGARITHMIC SCALE)
10000
9000
7000
6000
5000
4000
3000
2000
1000
800
700
600
500
400
300
200
100
80
70
60
50
40
30
20
10
0
20
40
60
80
100
120
140
160
180
200
220
240
POPULATION RANK

3. Order or array the communities in accordance with the number of trade and service agencies contained, and alongside of each community list the names of the kinds of establishments represented by these agencies.

4. On this array, draw a line dividing off those communities having less than 10 trade and service agencies. Designate these communities by the name of "Hamlet." It is to be noted that nearly all of these contain grocery stores and elementary schools and not uncommonly also such agencies as filling stations, churches, and taverns.

5. From the rest of the array, i.e., those communities with more than 10 service agencies, select out the ones which have at least 50 retail and service establishments no less than 30 of which are agencies other than grocery stores, taverns, and filling stations and which include establishments or services of the following kinds: banking, newspaper publishing, high school, physician, dentist, lawyer, and veterinarian. Call these communities by the name of "Town."

6. Call the rest of the communities within the array -- that is, those containing more than 10 establishments and that do not satisfy the above requirements -- by the name of "Village."

Setting forth the rule in this manner emphasizes its arbitrary character. After having specified the criteria by which an enumerator may distinguish among various kinds of activities,[10] the observer has as his basic data the array of communities and the listing of the kinds of activities represented by the establishments in each community. There is no evidence that I have seen suggesting that exactly three natural partitions may be observed in this array of the numbers of establishments. Like pool, pond, and lake, the terms hamlet, village, and town are convenient modes of expression; but they do not refer to structurally distinct natural entities. As the number of establishments increases, the number of kinds of activity represented also increased. Clearly, it is arbitrary to divide the array into three partitions rather than into a greater or lesser number; and similarly arbitrary is the determination of where to put the dividing points separating the different classes or types. Having drawn the lines, one may list certain kinds of activities which are typically found within each of the designated classes of center, and the following table from Mr. Brush's article represents such a listing. It will be noted that not all members of a class will contain all the activities listed and most of the communities within a class will contain activities not listed. Such a table is not an independently derived basis for a classification of communities by type. Rather it is itself derived from a previous partitioning of an array which appears as something similar to an arrangement of observations that have been made upon a continuous variable.

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(10) Conventional modes of classifying kinds of activity would seem to be ambiguous for the purpose of inter-community comparisons. While there are physicians, for example, in small places that are similar to some physicians in large places, there are other physicians in these large places for which there are no counterparts in small places. The same holds true for other classifications -- grocery stores, clothing stores, restaurants, law offices, banks, et cetera.

Table 2

FUNCTIONAL CLASSES OF TRADE CENTERS IN SOUTHWESTERN WISCONSIN
1949-1950

Associated Functional Units[a]	44 Hamlets[b] Population Mean, 65 Range, 20-300	73 Villages Population Mean, 481 Range, 115-1415	19 Towns Population Mean, 3324 Range, 1329-7217
Retail Trade	Grocery or General Store	Tavern Filling Station Auto and/or Implement Dealer Hardware Store Appliance Store Lumber Yard Food Store	Food Specialty Store Restaurant Drugstore Department Store Apparel or Shoe Store Variety (5 & 10 cents) Fuel Dealer Florist Furniture Store Jewelry Store
Wholesale Trade	. . . . .	. . . . .	Livestock Buyer Bulk Oil Distributor
Finance	. . . . .	Bank	Insurance Agency
Trades and Personal Service	. . . . .	Auto Repair Shop	Electric Repair Shop Shoe Repair Shop Undertaker (Mortician) Portrait Photographer Barber Beautician Dry Cleaner Hotel
Amusements	. . . . .	. . . . .	Movie Theater Billiard Hall Bowling Alley Public Park
Transportation	. . . . .	Livestock Trucker Milk Trucker Freight Truck Line	Railroad Freight Depot Passenger Bus Line Local Dray
Communication	. . . . .	Post Office Telephone Exchange	Weekly Newspaper
Utilities	. . . . .	. . . . .	Water System Sewage System Electric Power Distribution

Table 2 (continued)

Associated Functional Units	44 Hamlets Population Mean, 65 Range, 20-300	73 Villages Population Mean, 481 Range, 115-1415	19 Towns Population Mean, 3324 Range, 1329-7217
Manufacturing	. . . . .	Feed Mill	Bakery Printing Press Dairy Processing Plant
Professional Services	Elementary School	Church High School[c]	High School Physician Dentist Health Practitioner Veterinarian Lawyer
Government	. . . . .	Village	City (4th Class)

a/ Sources: Dun and Bradstreet's "Reference Book for Wisconsin, 1949"; telephone directories and business or professional directories. The types of functions listed occur in at least 75 per cent of the centers in each class and are considered to be distinctive of each successively higher class in the hierarchy.

b/ Only hamlets investigated by the author are reported because of the unreliability of published sources.

c/ High schools are found in 70 per cent of the villages.

6. While our map with the distributed stacks of chips would provide the information required for the application of Bogue's rule for selecting out his metropolitan centers and for delineating the boundaries for his hinterland areas, the map and chips as they have been described above would not provide enough information for a classification of central places into something like Christaller's types. To provide the information required for the application of a rule conforming with Christaller's conception, such as the rule described above, we would have to devise a way for distinguishing the chips in accordance with the kinds of activity engaged in by the individuals represented -- say, different colors for different kinds of activity.

Supposing that we were to have such a map before us, let us attempt to visualize what we would see. The smallest communities -- those that would be "hamlets" in Mr. Brush's classification -- would be represented by small stacks showing a limited number of colors. Mr. Brush would recognize them as "hamlets" -- applying his rule which we described above -- by their height and by the number of colors in the stack. "Villages" would be observed as somewhat higher stacks containing, in addition to the colors shown in the

lower stacks, certain other colors. "Towns" would be taller and would contain additional colors. If the area were extended to include larger and larger places, we would see the taller stacks containing colors in addition to those showing in smaller stacks, and this continuing addition to the number of colors as height increases would proceed up to the tallest stack.

However, in speaking of these different colors corresponding to different kinds of activity, we beg the question of how to specify kinds or classes or types of economic activity. In Christaller's conception, the type of a central good or service refers to what he thinks of as the range of that good or service. His particular geometric arrangement -- which I look upon as an illustrative device and which he looks upon, in a way that I do not understand, as an "expectation" -- implies that the range of one type is $\sqrt{3}$ times the range of the next lower type. The region which in this conception he centers upon a particular central place is a hexagon circumscribed by a circle with radius equal to the "range" of that type of central good characteristic of that type of central place. But for any defined class of goods or services -- and the common notion of "commodity" refers to nothing more than some agreed upon definition of a class -- that which one observes is not a "range" but a distribution of distances covered by units of output from site of production to site of consumption, however these may be defined. The notion of "range" refers to some kind of average calculated on the basis of this distribution. The "ranges" of the various commodities and services, in this sense of average distance from site of production to site of consumption, do not fall naturally into distinct classes in terms of which "types" of goods can be directly observed. Rather, these averages show continuous variation among the different goods. Also, the "range" of a central place refers only to some kind of average of a distribution of distances, so that any circle drawn about a center, circumscribing some geometric shape, represents no more than an arbitrary cutting off of a part of what is essentially a distribution of a continuous variable.

If the idea of range is the essential notion in the conception of a hierarchy of central places, we may conceivably relate our colorations directly to some measure of distance rather than indirectly by way of designations of kinds or types of economic activity. Suppose, then, that instead of associating an individual chip with a defined type of activity, we consider the value-added by the individual represented by the chip and the loci of the domiciles of the consumers of the units of this value-added. Without regard to kinds of activity, there would be an observable average distance separating the point at which the activity of the individual takes place and the points of consumption of the value-added resulting from this activity. Suppose that in some way we distinguish the chips in accordance with the magnitude of this average distance.

With the map so constructed, the chips representing individual family units and the colorings representing distance covered by the value-added produced by the family unit, we would directly observe as the primary data, not a spatial orientation of different types of central places, but only a distribution of different heights and different color compositions of stacks of chips. The height of a stack reflects the density of the clustering of producing and consuming units. The coloration of a stack would reflect the spatial range or "field" of interdependency directly involving the units represented by the

chips within the stack. Large clusters showing relatively extensive range would be seen as spaced over the area, and smaller clusters with more restricted "fields" would be interspersed among the larger in such a way as to give the impression of a hierarchy of centers. The structure as it would be observed would seem to be characterized by continuity and not by a discreteness that is suggested by the idea of some definite number of types of places.

7. While the above kind of construction would directly show the spatial distribution of individual population units, it would not directly describe the "fields" of interdependency among these units. The colorations representing average distances covered by outputs would be a condensation of information derived from a different kind of spatial distribution than that depicting the distribution of population units. That is, we may more directly view the flows of value output by observing on other maps the density systems or distributions of which the averages, shown as colors in the above example, are parameters.

Suppose now that we consider a single center and that we locate on a second map the domicile of the consumer of each unit of the value output resulting from activities during a time period of the population units belonging to this center. If a chip were placed on the second map at the point of consumption of each unit of this value output, the tallest stack would be at the center itself, for a large part of the value-added is consumed close to the point of production. As one moves out from the center, the height of the chips on this second map, as upon the first, would rapidly decline.

If there were some way to distinguish the chips by center of origin, we could place upon the same map the destinations of the value outputs of many centers. For centers that are far apart, there would be little intermixing of the chips. For centers close together, there would be an overlay of density systems of the sort suggested by Christaller's conceptual scheme.

Just as one might locate upon a map of this sort the destinations of the units of value output originating in a given center, so might we locate on a third map the originations of the units of value output that are consumed within the center. It would be found that the distribution of chips about a given center on this third map would resemble that shown on the second map although the chips in large part would represent different units of value. A considerable proportion of the value consumed within a center is also produced within or closely around the center. As one moves out from the center, the density of these chips representing origination points would show a rapid decline.

Here then are three density configurations in terms of which the spatial structure of an economic system is described. One of them describes the spatial distribution of the population units. A second describes for each center the destinations of the value output originating in the center. A third describes for each center the points of origination of the value outputs which have their destinations within the center. The second and third would be exceedingly complicated to construct. But they are not complicated to imagine. Were we to be stationed at some point on a line of transport, for example, and under such conditions that for each unit of value which passes that point we could determine its origin and destination, we could form a pair of frequency distributions of

these value units -- classifying the units by distance from origin, on the one hand, and classifying the same units by distance from point of destination, on the other. We shall interpret figures which we show below as suggesting that the forms of these distributions would look about the same whatever the point selected for the observations. Over the length of a great line of transport, the value of the cargo would seem to remain fairly stable. But this is kept so by a continuing adding-to and dropping-out process, so that the distance distributions that we might observe at any point along the way would assume forms that would look to be the same or similar. In terms of the forms of these distributions, a second aspect of the spatial structure is described.

8. In the earlier sections, we have made an effort to describe the spatial distribution of the population units. We shall in this section consider certain arrangements of data describing shipments of commodities, and we shall interpret these data as indicating the form of this other kind of distribution.

The data upon which the following figures are based are not value-added data, and they do not show distances between site of production and site of consumption of units of goods. They are derived from relatively large samples of railroad freight waybills and are in terms of carloads rather than value units. Referring only to commodities hauled by rail, these data describe the origins and destinations of a portion of the relatively long-haul commodity "exports" shipped from central places. Each carload presumably originates at some central place, but there is no classification of shipments by central places. The classifications that are made available are of carload lots by industry group and by state of origin and of destination.

I set forth below a tabular form which would be constructed for the presentation of distance distributions for various classifications of these carload shipments of goods. In this table, the percentage column for each class represents a distance distribution for that class. Each percentage figure in such a column gives the proportion of cars belonging to this class which traveled the indicated distance before reaching their destinations. For any set of cars, these classes are mutually exclusive and exhaustive, and the columns under "All Classes" refer to the total number of cars that are classified.

One may easily see that each percentage in this "All Classes" column is a weighted average of the corresponding percentages in the columns for the various classes. For example, the percentage of all the classified cars which traveled distance d_2 may be written

$$\frac{\sum_{j=1}^{N} X_{j_2}}{\sum_{j=1}^{N}\sum_{i=1}^{K} X_{ji}} = \frac{\sum_{j=1}^{N}\sum_{i=1}^{K} X_{ji} \dfrac{X_{j_2}}{\sum_{i=1}^{K} X_{ji}}}{\sum_{j=1}^{N}\sum_{i=1}^{K} X_{ji}}$$

On the left hand side of the equation is the percentage which would appear in the "All Classes" distribution for the second distance interval. On the right hand

Table 3

CLASSIFICATION OF FREIGHT CARS

Distance Interval	Class 1 No. of Cars	Class 1 %	Class 2 No. of Cars	Class 2 %	....	Class N No. of Cars	Class N %	All Classes No. of Cars	All Classes Proportion of Cars
d_1	X_{11}	$\frac{X_{11}}{\Sigma X_{1i}}$	X_{21}	$\frac{X_{21}}{\Sigma X_{2i}}$	. .	X_{Ni}	$\frac{X_{N1}}{\Sigma X_{Ni}}$	$\sum_{1}^{N} X_{j1}$	$\frac{\Sigma X_{j1}}{\Sigma\Sigma X_{ji}}$
d_2	X_{12}	$\frac{X_{12}}{\Sigma X_{1i}}$	X_{22}	$\frac{X_{22}}{\Sigma X_{2i}}$	. .	X_{N2}	$\frac{X_{N2}}{\Sigma X_{Ni}}$	$\sum_{1}^{N} X_{j2}$	$\frac{\Sigma X_{j2}}{\Sigma\Sigma X_{ji}}$
d_3	X_{13}	$\frac{X_{13}}{\Sigma X_{1i}}$	X_{23}	$\frac{X_{23}}{\Sigma X_{2i}}$	. .	X_{N3}	$\frac{X_{N3}}{\Sigma X_{Ni}}$	$\sum_{1}^{N} X_{j3}$	$\frac{\Sigma X_{j3}}{\Sigma\Sigma X_{ji}}$
.	.	.	.	.	. .	.	.	.	.
.	.	.	.	.	. .	.	.	.	.
.	.	.	.	.	. .	.	.	.	.
d_K	X_{1K}	$\frac{X_{1K}}{\Sigma X_{1i}}$	X_{2K}	$\frac{X_{2K}}{\Sigma X_{2i}}$		X_{NK}	$\frac{X_{NK}}{\Sigma X_{Ni}}$	$\sum_{1}^{N} X_{jK}$	$\frac{\Sigma X_{jK}}{\Sigma\Sigma X_{ji}}$
Total	$\sum_{1}^{K} X_{1i}$	1	$\sum_{1}^{K} X_{2i}$	1	. .	$\sum_{1}^{K} X_{Ni}$	1	$\sum_{1}^{K}\sum_{1}^{N} X_{ji}$	1

side is the weighted average of the class percentages for this second distance interval, the weight for each class percentage being the total number of cars in the class. If the percentages and the weights are uncorrelated, then this weighted average will the same as the simple arithmetic mean of the class percentages. On this assumption, we shall interpret the entries in the "All Classes" distribution as arithmetic means of the corresponding entries in the distributions of the component classes.

Let us first think of the classes as being commodity groupings. Class 1, for example, may be insulating materials, Class 2, crushed stone, et cetera. The columns would show the percentages of all cars hauling these commodities which traveled a specified distance. The Interstate Commerce Commission data provide classifications for over 250 commodity groups, so that in this case the N in the table is this number of commodity classes.

For each such commodity group, the average distance hauled may be computed, and we have suggested that this average would constitute a possible

Figure 7a

RELATIVE FREQUENCY DISTRIBUTION OF 257 COMMODITY CLASSES, BY AVERAGE DISTANCE HAULED BY RAIL, UNITED STATES, 1950

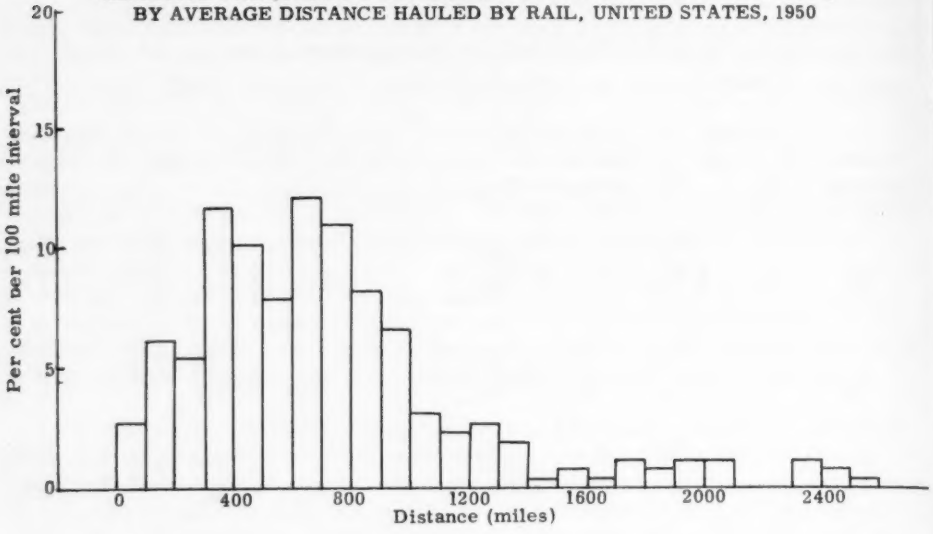


Figure 7b

RELATIVE FREQUENCY POLYGON SHOWING THE 252 COMMODITY GROUPS, BY AVERAGE DISTANCE HAULED BY RAIL, UNITED STATES, FIRST QUARTER, 1947, 1948, 1949, 1950

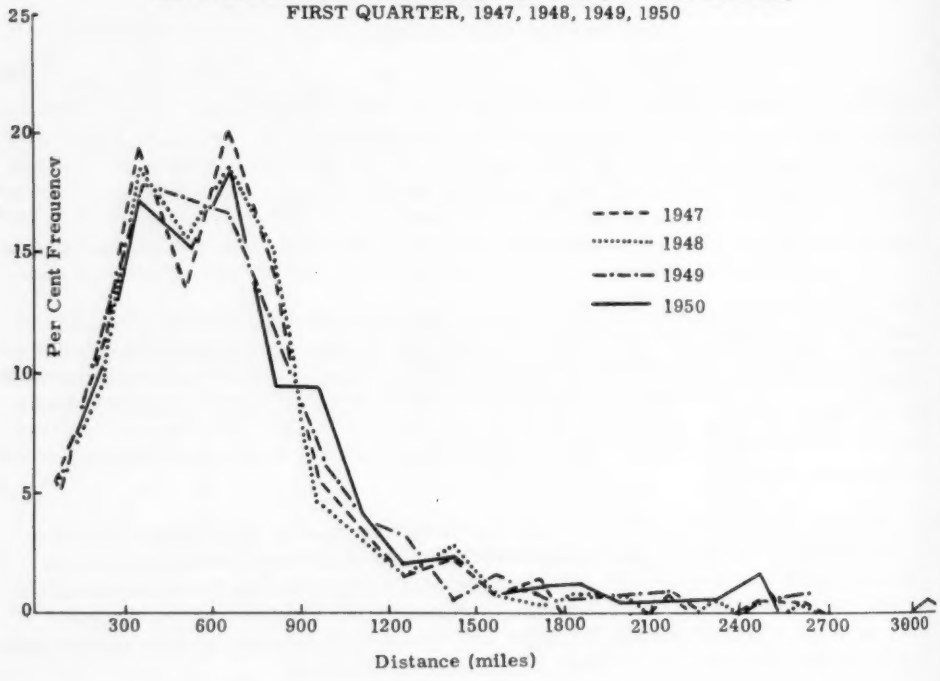
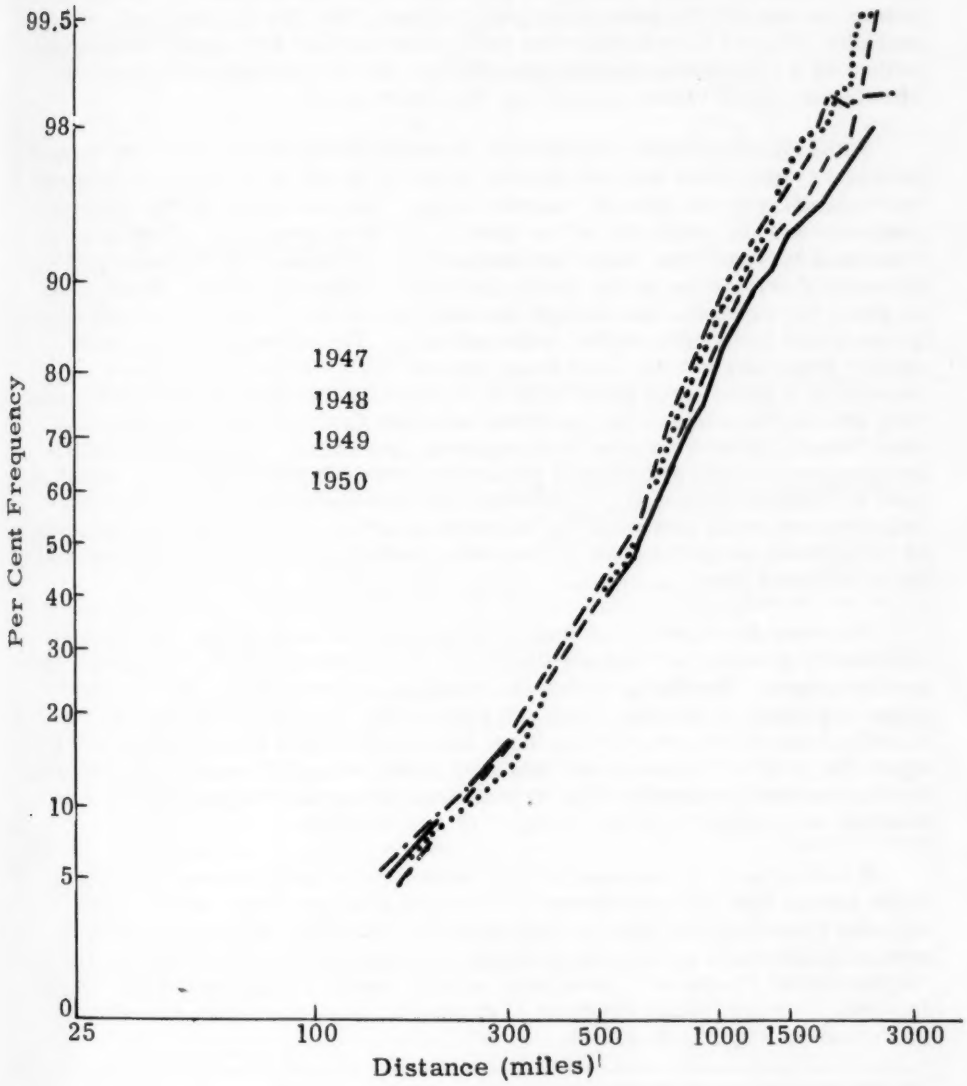


Figure 7c. CUMULATIVE RELATIVE FREQUENCY DISTRIBUTION OF THE 252 I. C. C. COMMODITY GROUPS BY AVERAGE DISTANCE HAULED BY RAIL, UNITED STATES, FIRST QUARTER, 1947, 1948, 1949, 1950
(Plotted on Logarithmic Probability Paper)



measure corresponding to the idea of "market range of a commodity." From the ICC data we have such averages for over 250 commodity groups, and Figures 7a-7c describe the variation among these average distances hauled.[11] The averages range from less than 25 miles to over 2000 miles, indicating the great differences among the distance distributions of the various commodity groups. Figures 7b and 7c show the stability of these distributions over the four year period. The average distance for an individual commodity group would be found to differ from year to year. Also, the commodity groups themselves are not all the same from year to year. Yet, the distributions show a stability. Figure 7c indicates that these distributions are approximately described by a logarithmic normal distribution, the two parameters of which showing not much variation over the four year period.

Although these data associate an "average distance hauled" with each commodity group and we have spoken of this average as a possible measure corresponding to the idea of "market range," the weakness of this correspondence and the ambiguity of the idea should be emphasized. This is a "national average" and would not correspond to the average distance for those cars originating at any particular place within the nation. From state to state, for example, the average distance hauled for a particular commodity group would be found to differ systematically. The components of a commodity group are not the same from state to state. Even though these components of a group were physically or chemically the same in different states, they are not the same in the purposes and uses to which they are put. The coal industry in some places is an essential part of the steel industry while at other places it is primarily a part of the electric power industry, which in turn is oriented differently in different parts of the nation. So is the steel industry connected with different kinds of activities in different spatial parts of the system, as is the case for any other set of producers of products having many different uses.

Whereas this first set of figures show only the averages of the various commodity groups, the next set illustrate entire distributions for certain commodity groups. Insulating materials, oranges and grapefruit, and crushed stone are three of the more than 250 commodity classes. In Figure 8a the distributions of the cars hauling these commodities are shown, illustrating again the great differences that would be found among the percentage columns for the various commodity classes and illustrating also the ambiguity of an average as a measure of the "range" of a commodity.

If such a table as the one we have shown above were presented for only those groups that are considered to belong to a larger class called Agricultural Commodities, then the aggregate or "All Classes" column in this special table would contain the distance distribution for this broad class "Agricultural Products." Similarly, a table could be constructed for "Manufactures," or for "Mine Products," et cetera. Such aggregate distributions are shown in Figures 8a and 8b.

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(11) These figures of the ICC data and those shown below were constructed by Jere Clark and are included in his dissertation, "A Study of Interregional Commodity Flows." This dissertation is deposited in the Library at the University of Virginia.

Figure 8a. PERCENTAGE OF CARLOADS OF RAIL FREIGHT SHIPPED LESS THAN INDICATED DISTANCES, 1950

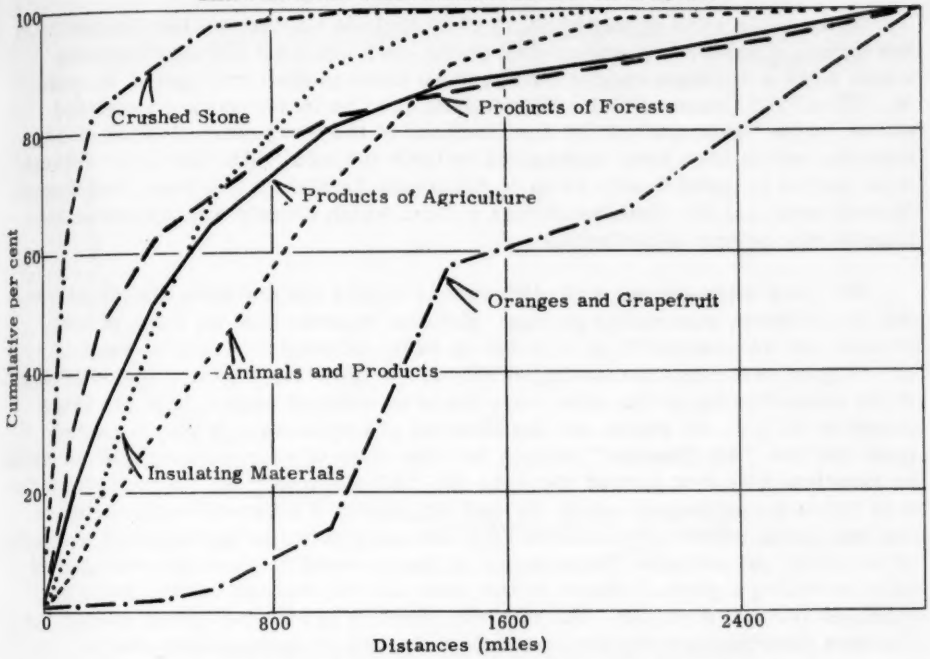
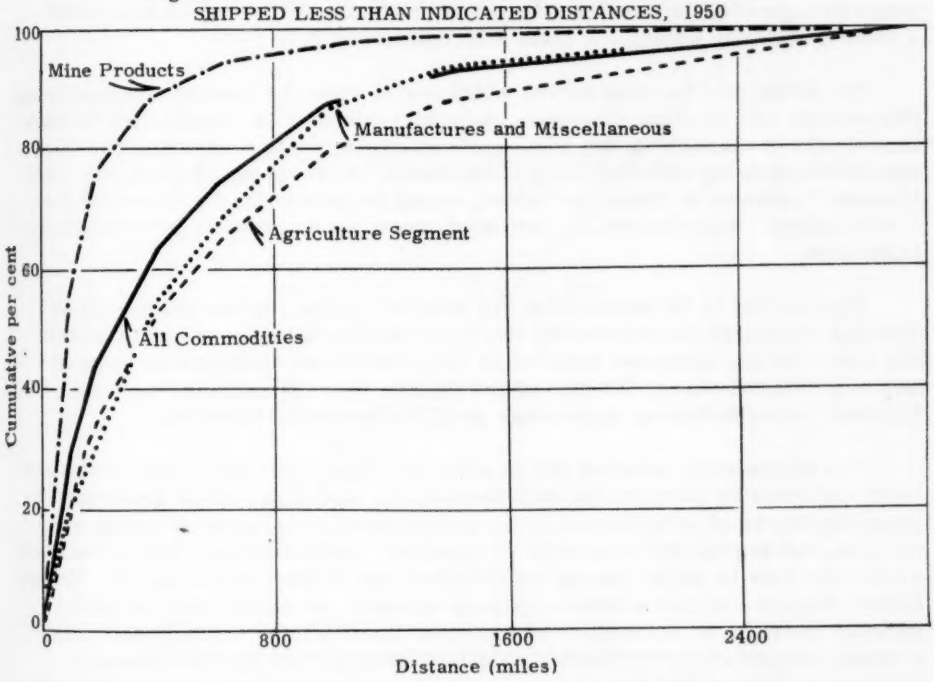


Figure 8b PERCENTAGE OF CARLOADS OF RAIL FREIGHT SHIPPED LESS THAN INDICATED DISTANCES, 1950



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If the table were constructed so as to include all carload lots hauled in the nation, classified by commodity group, then the "All Classes" column would show a distance distribution such as those plotted on Figures 9a and 9b. This "All Commodities" distribution is to be interpreted, as outlined above, as an "average" of the distributions of the component classes of commodities which have been aggregated to form the total "All Classes" column. It is plotted in these charts so as to illustrate its stability in time, and Figure 9b indicates that the distribution has a form which closely approximates the logarithmic normal distribution.

We have stressed the wide differences among the distance distributions for the different commodity groups. But now suppose that we think of the classes not as commodity groups but as areas of origin -- that is, each car is assigned to a class consisting of all cars originating within a specified area. If the classification of the cars were made by state of origin, N in the table would be 49 (i.e., 48 states and the District of Columbia). It may be noted first that the "All Classes" column for this state of origin classification would be identical with that plotted above as the "All Commodities" distribution, for it is the same aggregate set of carload lots that are differently classified in the two tables. The "All Classes" percentage figures being weighted averages of the class percentages, the average of the commodity class percentages of cars traveling a given distance is the same as the average for the state percentages for that distance. But whereas there is great divergency among the distance distributions for the commodity classes -- some commodities traveling only short distances from points of production and others being consumed great distances from points of production -- there is to be noted a close similarity among the state distributions.

One table may be constructed which would show the results of classifying the carload lots by state of origin. Another table may be constructed to show the results of classifying the same carload lots by state of destination. The two tables showing different classifications of the same set of cars, the "All Classes" columns in these two tables, would be identical. We interpret this "All Classes" distribution, as indicated above, as an average of the state distributions.

Figures 10a to 10f present for six selected states the two distributions showing the distances covered by the cars which originated at points within the state and the distances covered by the cars whose destinations were at points within the state. On each of the figures there is included the "All Classes" distribution as an average of all the state distributions.

The states were selected not in order to obtain similarity but, on the contrary, in order to observe the distributions for states that show great differences in degree of urbanization, size and shape of area, general topography of area, and degree and character of economic specialization. Yet, a marked similarity may be noted among the distributions of the various states. Rhode Island (Figure 10a) has a relatively large number, as compared with the national average, of its originated cars that terminate within 200 miles and a small number of its terminated cars that originate within that distance. California (Figure 10b) has relatively small numbers of both terminated and originated cars in the middle distances, from 200 to 1000 miles, and it has a

Figure 9a
RELATIVE FREQUENCY POLYGON SHOWING NUMBER
OF CARS OF RAIL FREIGHT, BY DISTANCE HAULED, ALL COMMODITIES,
UNITED STATES, 1949, AND 1st QUARTER OF 1947

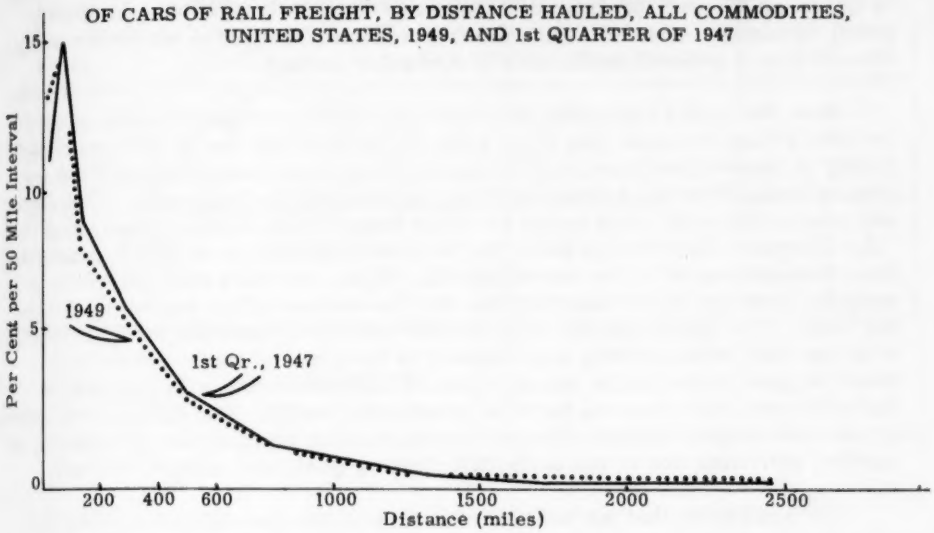
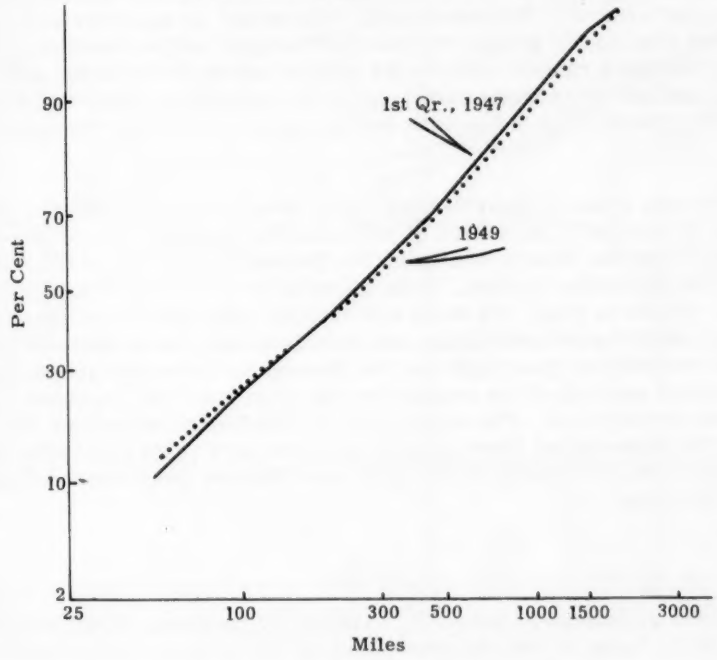


Figure 9b
CUMULATIVE RELATIVE FREQUENCY DISTRIBUTION
OF CARS OF RAIL FREIGHT CLASSIFIED BY DISTANCE HAULED,
ALL COMMODITIES, UNITED STATES, 1949, AND 1st QUARTER OF 1947
(Plotted on Logarithmic Probability Paper)



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relatively large number of cars in the long distances. The cars terminating in Colorado (Figure 10f) from distances of 200 to 1000 miles are relatively small in number. But all in all, the impression conveyed to me by these figures is one of general conformity to a regular pattern.

Now, the cars originating in a state presumably originate at some city or town within the state; and if we were to consider the set of all cars originating in some given state, say Michigan, these cars could be classified by city or town. That is, a table could be constructed for each state. The cities and towns within the state would be at the heads of the class columns and the "All Classes" distribution would be the state distribution of which examples have been presented in the above figures. Thus, the state distribution is a weighted average of the distributions for the various cities and towns within the state. The above figures show a close similarity between the distributions of states that differ greatly with respect to the sizes of their cities. This would suggest a similarity among cities of different sizes with respect to their distance distributions for this commodity traffic. The differences among cities with respect to their "range" would appear, then, in the differences of service activities and in the activities yielding goods not shipped by rail.

The similarity that we have noted refers to the general form of the distributions, and in Figures 11a and 11b the form and stability of the distributions are further illustrated. But there is an important difference among states (or cities) which these charts do not show. In the short-distance ranges of all the distributions are found about the same commodity groups. This would be seen in the state classification table if the cars were tallied in such a way that commodity groups could be distinguished. But as one moves along the distance scale there is more and more divergency among the states with respect to the commodity groups represented in their respective distributions. The long-distance ranges indicate the specialization of the area, and in the sparsely settled areas this specialization is confined to a smaller number of commodity groups than is the case for the areas containing the larger central places.

These two types of distributions, then, would seem to describe the physical features of the spatial structure of an economic system. One of the distributions describes the density configuration formed by the loci of the individual units of the population system. This distribution describes the positions of things at a point in time. Its form and stability are population characteristics and do not refer to any particular set of individuals. Individuals are born, live their respective lives, and die, but throughout the continual changes in the individual makeup of the population, the population as a system shows stable features of form. The other type of distribution describes the destinations of the value-output flows emanating from each point within the area. These two types of virtually continuous distributions describe the essential spatial structure.

II

1. We have attempted to describe, in terms of frequency distributions, various aspects of the form or pattern observable in the structure of a human population

Figure 10a. PERCENTAGE OF CARLOADS OF RAIL FREIGHT SHIPPED LESS THAN INDICATED DISTANCES, RHODE ISLAND, 1950

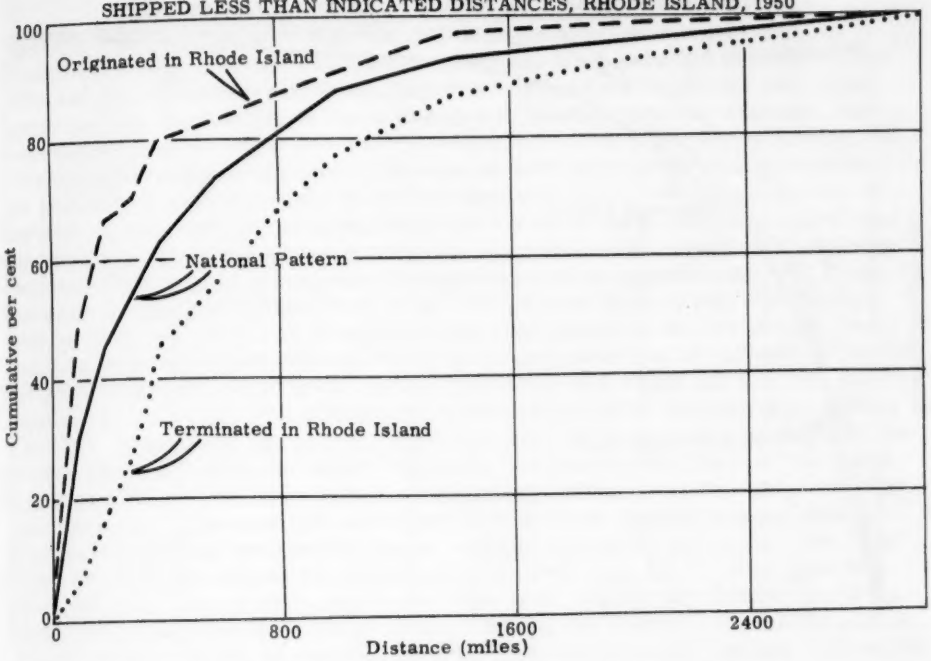

Figure 10b. PERCENTAGE OF CARLOADS OF RAIL FREIGHT SHIPPED LESS THAN INDICATED DISTANCES, CALIFORNIA, 1950

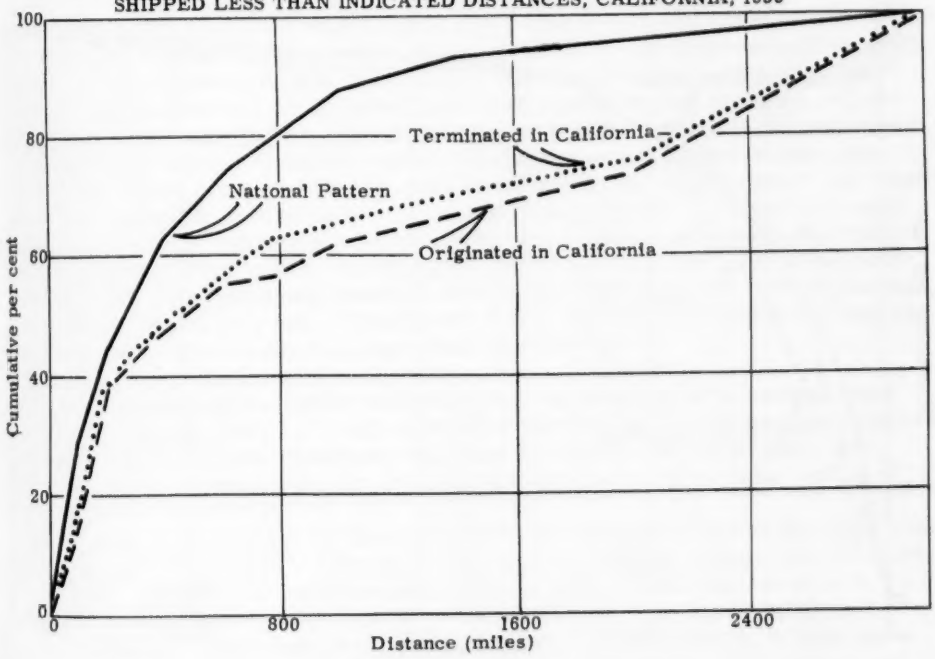

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Figure 10c. PERCENTAGE OF CARLOADS OF RAIL FREIGHT SHIPPED LESS THAN INDICATED DISTANCES, ALABAMA, 1950

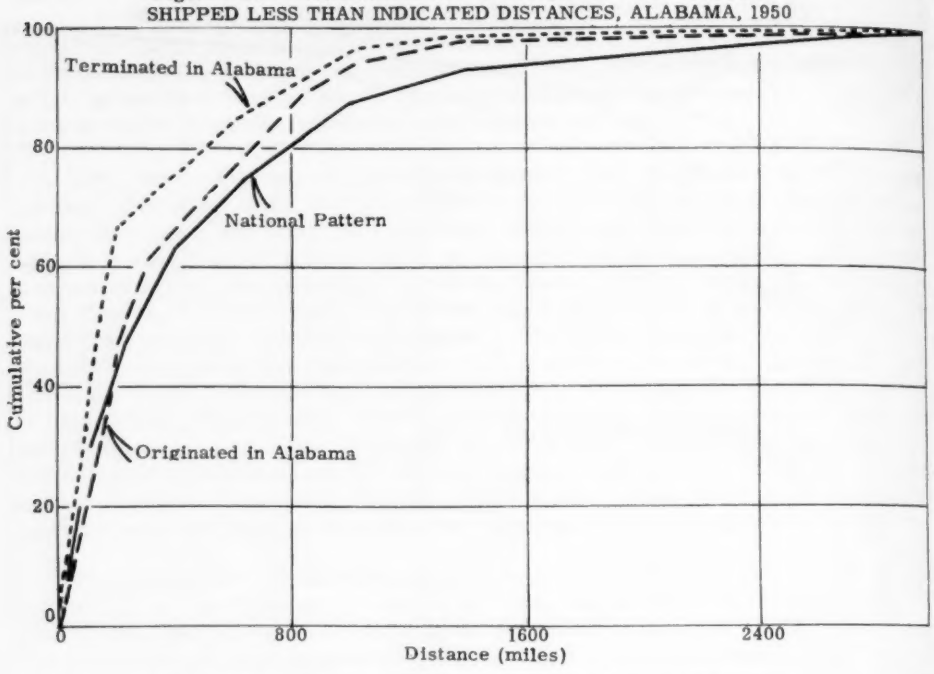
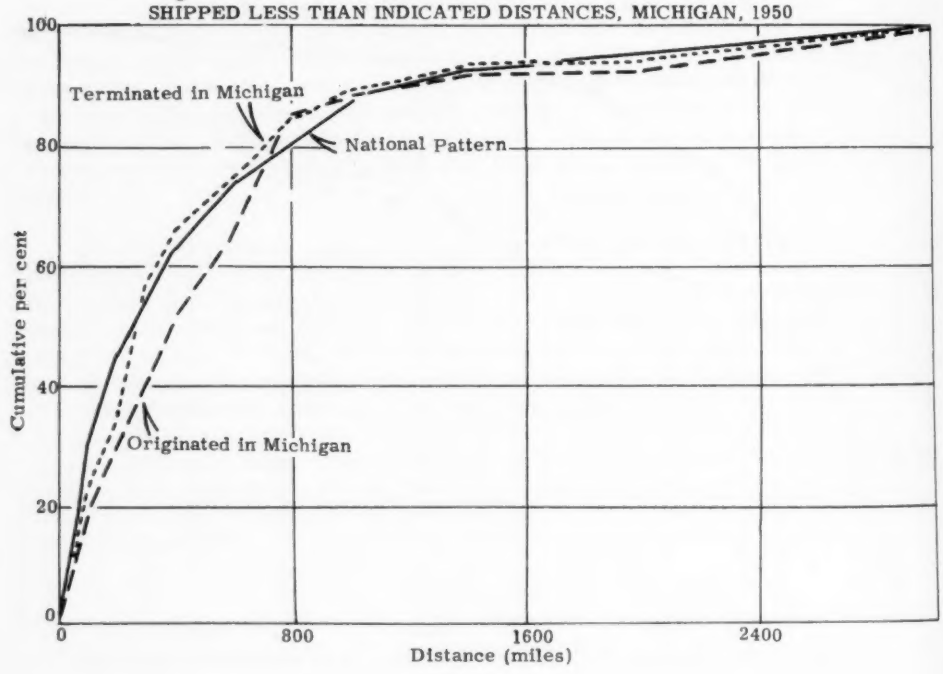


Figure 10d. PERCENTAGE OF CARLOADS OF RAIL FREIGHT SHIPPED LESS THAN INDICATED DISTANCES, MICHIGAN, 1950



system. It was suggested that the distributions may be characterized by analytical forms and that changes in conditions have over the course of time affected the parameters of these distributions but that the forms have been more or less insensitive to these changes in conditions. For example, the cumulative greater-than size distribution of cities in 1950 when plotted upon double logarithmic graph paper appears as a straight line sloping downward at an angle of approximately forty-five degrees. Given the slope and the intercept on the vertical axis, one may quickly draw off a line from which may be read the number of cities containing more than some specified number of people. This is only an empirical observation of an approximate "fit," and no analysis has been given from which the precise form of this distribution can be inferred. But with an appropriate adjustment of the two parameters, the intercept and slope, the distribution for any other decade since 1790 would be given approximately by the straight line; and one might not feel too uncertain about a straight line which he may draw describing the size distribution for 1960 or for 1970. Moreover, there are persons who state that the size distributions of the cities of other "systems" are similarly fitted by the same form of distribution. As another example, the cumulative less-than distance distribution of car-load lots of freight plotted as an upward sloping straight line on logarithmic probability paper. Again, one might feel some degree of confidence in describing the distribution for next year by drawing such a straight line. And it was conjectured that some stable distribution would be found if we had data for a large center showing the destination of each unit of value-added. These, of course, are only tentative descriptions and hypotheses regarding the stability of forms of distributions.

If for the present we may assume that some process of development leads in the limit to stable distributions of the sort that we have described, we shall point out and emphasize that although the distributions are stable, the individual units within the distributions are always shifting and changing and are in a continual state of flux. The regularity and order pertain to the population system as an entity. Considering the happenings of any period of time, we know that there are some family units that die and pass out of existence, others that are born and created anew. In regard to any central place, some family units move away and settle in other places while some move from other places and into this central place. In all places there is a continuing birth and death, adding-to and dropping-out process, some places growing and some declining as a result of the process. Through all of this internal and individual flux, the system as a whole is maintaining a kind of stability.

2. The continuing movement of family units into and out of a central place may also be described in terms of relative frequencies of occurrence of moves of specified distances. Each central place is looked upon as an absorption point and a dispersion point for migrating individuals. In various studies,[12]

(12) The work that I have in mind goes back to the studies of Ravenstein, "The Laws of Migration," Journal of the Royal Statistical Society, XLVIII (1885) and LII (1889). A contemporary study to which I refer is that of S. A. Stouffer, "Intervening Opportunities: A Theory Relating Mobility and Distance," American Sociological Review, V (1940), which, in turn, gave rise to two subsequent studies published in the 1941 and 1944 volumes of

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generalizations have been made in regard to these movements. Moves are predominantly for short distances, the relative frequency with which moves of specified distances occur becoming smaller as distance increases. Cities have grown from net in-migration primarily through movements of individuals from the immediately surrounding area, and this loss within these surrounding areas is to a greater or lesser extent compensated by in-moves from still farther out.

Stouffer has suggested a mathematical form for describing this aspect of human migration. He was led to the form of relationship which he regards as a "fit" for the data that he has studied not by an analysis of a well-defined process of development but by more or less plausible and common sense rationalization. The common sense reasoning is something like the following: The individuals who move during a period will have made choices among alternative opportunities for gaining a livelihood. For the individuals living within a designated neighborhood there exists some number of opportunities within a given radius of the neighborhood that if known to the individuals would be sufficient for the inducement of moves. This number x increases with the length of the radius s. But the individuals are aware of less than the number of opportunities which actually exist, such that as x increases with s, the opportunities that are known to the individuals increase more slowly. Assume that the number of moves to places within a given radius is directly proportional to the number z of these apparent opportunities. That is, with the number of moves being represented by y, let $y = kz$. Now assume, in accordance with Fechner's law pertaining to perception, that z, the apparent opportunities, is related to x, the actual opportunities, by the equation $z = m \log x + c'$. By substitution, we have that $y = a \log x + c$. Finally, on the assumption that x is related to area by the equation $x = ks^b$, we have $y = A \log s + b$.

It may be noted that the first derivative of this last equation, giving the frequency function of moves of length s, is $y' = A/s$, which is of the form of the Pareto distribution that was briefly discussed on an earlier page. Stouffer regarded his study as a test of the hypothesis that the number of persons moving a given distance is directly proportional to the number of opportunities at that distance and inversely proportional to the number of intervening opportunities. If the number of opportunities x within a radius s is related to x in the way assumed above -- i.e., if $x = ks^b$ -- then this hypothesis is equivalent to the hypothesis that the number of moves of a given distance is inversely proportional to the distance, which is expressed by the above relationship, $y' = A/s$.

Whatever the form of the relationship describing human mobility, there exists a continual movement of individual units to and fro. A stack of chips representing a central place upon our map as it would stand today will consist of chips some of which would have been found in other stacks on a map depicting the situation existing a year ago. Census data describe some of this. 81% of the individuals in this country lived in the same houses in 1950 that they occupied in 1949; about 11% lived in different houses but in the same counties;

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the same Journal, "Interstate Migration and Intervening Opportunities," by M. L. Bright and D. S. Thomas, and "Internal Migration in Sweden and Intervening Opportunities," by E. C. Isbel.

and about 6% lived in different counties.[13] Over a period longer than a year, of course, more of the population are found to have moved about. In 1947, 43% of the population lived in the same houses which they occupied in 1940; 36% lived in different houses but in the same counties; 11% lived in different counties within the same states; 4% lived in contiguous states; and 6% lived in states not contiguous to the 1940 states of residence.[14]

3. Thus, the individuals which we observe are not "at rest," nor are they ever "tending to a state of rest." There is a continuing state of motion among the individual units. But at any point in time they are distributed among the arbitrary small areas into which the total area is partitioned; and this distribution tends to maintain a regular and stable form. This is the kind of situation described by the idea of statistical equilibrium.

Discussions familiar to all economists imply this idea. Most persons who have worked with the data expect to find a distribution of typical form when the incomes of families are arranged by size. Many would feel confident that if given as many as two parameters of the distribution they could construct a close approximation to the entire distribution. Now the conjecture is not infrequently expressed that if existing wealth were arbitrarily apportioned equally among all the families so that in an initial period each family receives the same income, and if in subsequent periods each family is allowed to choose its mode of use of its resources, then it would be only a matter of time before income would again be distributed in accordance with the form which described the distribution prior to the arbitrary change. The family units would be differently placed within the distribution; but a shifting of individual units within the distribution would occur in time even though no arbitrary change were made. Whatever is done, individuals in the course of time move along the scale, passing from income class to income class. The typical form of the distribution that is thought by many to be stable will be stable only if these passages of individuals are mutually compensatory when this particular form is established. This is a limiting form, representing an equilibrium situation, if a disturbance which alters the form of the distribution renders the passages of individuals from class to class no longer compensatory but such that the typical form tends to be again restored.[15] This may or may not be so for our case of the income distribution, but all of us have heard statements in this context implying this conception of statistical equilibrium.

In the case of the movements of individuals, the apparently stable size distribution of central places is suggestive of such a statistical equilibrium.

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(13) 1950 Population Census Report P-B1, Table 70, pp. 1-121.

(14) "Internal Migration in the United States: April, 1940, to April, 1947." Current Population Reports, Series P-20, No. 14, Department of Commerce, pp. 2, 13.

(15) The idea is that of a stochastic process possessing ergodic properties. Cf. William Feller, "On the Theory of Stochastic Processes, with Particular Reference to Applications," Berkeley Symposium on Mathematical Statistics and Probability, Berkeley, 1949, p. 418.

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Fig. 11a. PERCENTAGE FREQUENCY DISTRIBUTION OF OBSERVED NUMBER OF CARS OF FREIGHT ORIGINATING IN VIRGINIA SHIPPED GIVEN DISTANCES, COMPARED WITH THE NUMBER INDICATED BY THE LOGARITHMIC NORMAL DISTRIBUTION, BY DISTANCE INTERVALS (MANUFACTURES AND MISCELLANEOUS), 1948

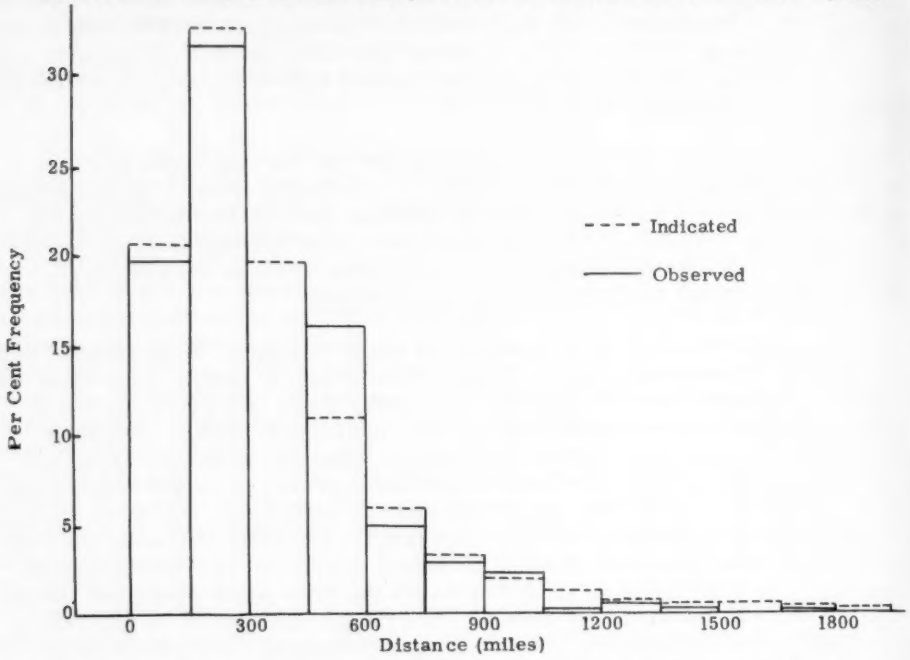
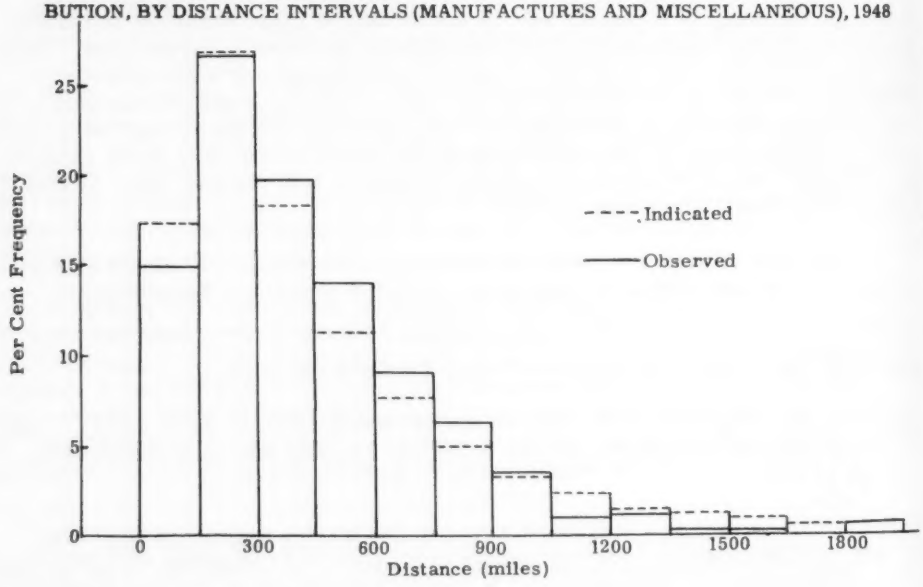


Fig. 11b. PERCENTAGE FREQUENCY DISTRIBUTION OF OBSERVED NUMBER OF CARS OF FREIGHT TERMINATING IN VIRGINIA SHIPPED GIVEN DISTANCES, COMPARED WITH THE NUMBER INDICATED BY THE LOGARITHMIC NORMAL DISTRIBUTION, BY DISTANCE INTERVALS (MANUFACTURES AND MISCELLANEOUS), 1948



Through a continuing process of births, deaths, movements into and movements out of designated small partitionings of a large area, a particular form of density configuration is established. The passages of individuals from sub-area to sub-area do not alter this form. But if the form of the distribution were arbitrarily altered -- for example, suppose that by the actions of some all-powerful authority individuals and equipment were moved about in such a way that all central places were made the same size -- then these passages of individuals would tend to change this arbitrarily established distribution. And if the original distribution does in fact conform with the idea of a state of statistical equilibrium, then the arbitrarily established equal distribution of individuals among designated sub-areas would be changed, through a process of undirected individual passages from sub-area to sub-area, back to the original distribution. This would not mean a reestablishment of the old cities but rather a development in time of a system of central places having the same general features of form.

4. This idea of statistical equilibrium is here being raised for brief discussion in order to consider and speculate upon the kind of analytical problem that confronts a student of the phenomena that we have attempted to describe. If we have in what we would observe upon our map or series of maps an empirical counterpart of this concept of statistical equilibrium, our problem is that of analyzing a time-dependent stochastic process. I am not such a one who will make a significant start upon this kind of application of the theory of probability. But I shall continue for a few paragraphs and try to illustrate some of the ideas.

One need only reflect upon the present residences of those with whom he was raised in order to realize the extent of the mobility of human beings. My own experience is not unusual, and in the course of twenty-five years I have moved a number of times. When I recall the chance happenings which apparently determined my various moves, it seems not unreasonable for me to look upon my present residence as the result of a sequence of chance occurrences. Let us consider the meaning, then, of a statement that some chance process determines the distribution of individuals over an area such as that of this nation.

Let us again think of the large map of this country upon which are to be placed the chips representing the family units constituting the population. Suppose, as a preliminary example, that we consider a chance distribution of the chips over the map on the basis of the simplest conceivable physical assumptions:

> Let the individual chips be numbered from 1 through r, there being r chips to be distributed over the total area. Let the total area be partitioned into N domains, each with unit area, and let these be numbered from 1 through N. Assume that an urn has been prepared containing N balls numbered 1 through N. For each of the chips draw a ball, replacing the ball after each draw, and assume that each draw is made in such a way that the chance of any particular ball's being drawn is 1/N. Place the chip in the domain corresponding to the number drawn.

As a result of the sequence of r draws, there will be domains containing 0, 1, 2, 3, . . . chips. Let N_k be the number of domains containing exactly k

chips, and let $P_k = N_k/N$ be the proportion which this number is of the total number N, so that $P_o + P_1 + P_2 + \ldots = 1$. Under these circumstances, the expected value of P_k is given approximately by $\frac{e^{-\lambda}\lambda^k}{k!}$, in which λ represents the average number of chips per domain and is equal to r/N. That is, having distributed the chips in accordance with the above random procedure, we may then classify the domains with respect to the number of chips contained. The respective proportions of domains containing 0, 1, 2, 3, . . . chips is given approximately by[16]

$$e^{-\lambda}, \quad e^{-\lambda}\lambda, \quad \frac{e^{-\lambda}\lambda^2}{2!}, \quad \frac{e^{-\lambda}\lambda^3}{3!}, \quad \ldots\ldots\ldots$$

The above approximately describes the expected results of a single performance of an experiment consisting of a random assignment of r chips among N sub-areas. Now suppose that this experiment is performed in each of a succession of time periods. That is, let us say that at the beginning of each time period, each of the r chips is assigned to a sub-area in accordance with the procedure outlined.

The location of each chip could be recorded for each time period, and the movements of the individual chips could then be traced. There would be a chance that a chip will not be moved from one period to the next, but this chance is very slight, and we may take for granted that each chip moves in each period. There would be as much chance that a chip would be moved to one particular sub-area as to any other. Hence, if we were to classify the individual moves from a given locality by the distances covered we would find that the proportion of total moves increases with distance. For assume that the sub-areas are of equal area and of many and various shapes, and let distance be measured by the number of sub-areas traversed. If the sub-areas are small, there are approximately $2\pi d$ sub-areas which lie d units of distance from some given sub-area. Thus, the chance that a move will carry exactly d units of distance is approximated by $2\pi d/N$, which increases with d.

It has been indicated above that the proportion of sub-areas containing exactly k chips would be found in any period to be approximately

$$\frac{e^{-\lambda}\lambda^k}{k!}$$

This would describe the frequency distribution of the stacks of chips classified in accordance with height. If the total area were divided into several departments -- ten or twenty or thirty or so -- then, if N and r are sufficiently large, within any of these divisions the proportions of places containing k chips would be given approximately by the same formula,

$$\frac{e^{-\lambda}\lambda^k}{k!}$$

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(16) There are numerous empirical examples of processes which result in spatial distributions conforming to these expectations. Illustrations, e.g., are given by William Feller, Probability Theory and Its Applications, New York, 1950, pp. 118-123.

That is, among the different geographic divisions or departments the range of height of the stacks would be about the same, and the number of stacks of a given height for each stack of some other height would be about the same for one geographic division as for another. It is conceivable that one who only observes the results would interpret what he sees as a "system of places," each "larger" stack being associated with some number of "smaller" stacks. However, there would be no stability or continuity from period to period in the height of a given stack. The number of chips found in a particular sub-area in one period would be independent of the number found there in the subsequent period. A concentration of chips would build up in one period and vanish in the next, and moderate sized rates of growth or decline would be virtually non-existent.

It will be noted that attention has been called to four quantitative aspects of the model process: the first has to do with the mobility of the individuals constituting the population; the second with the size distribution of the observed concentrations of chips; the third with the spatial orientation of the stacks of various sizes; and the fourth with the growth or decline of the population of the sub-areas or places. A particular form of behavior has been attributed to the model as a performance characteristic corresponding to each of these aspects. The performance ascribed to this model is of course not in conformance with any observations that have been made upon real population systems; for the fundamental assumptions of the model are not consistent with empirical observations. We shall now review some of these assumptions.

5. In the above illustration it was assumed that in each period the chance of a given chip's being placed in one sub-area is the same as the chance of its being placed in any other, viz., 1/N. On this assumption, the chance of a chip's remaining in a sub-area from one period to the next is this small number 1/N. But it was noted earlier, that only 2 out of 10 persons moved at all between 1949 and 1950 and that 1 of these 2 moved no farther than from one house to another within the same county. Only about 1 out of 10 persons moved far enough to change their counties of residence during that year, and most of these moves were to nearby counties.

It would be in keeping with experience, then, for us to construct the urn schema in such a way that the chance of a given chip's moving to a particular locality would be made to depend upon the distance of the locality from the present location of the chip. That is, with all other conditions the same, we should make the probability of a move vary inversely with the distance of the move.

But sub-areas differ, of course, in respects other than distance from a given point. On the one hand, they differ in their natural endowments -- proximity to lines of transport, quality of soils, climate, accessibility of minerals, et cetera. These would be initial differences that are independent of the process. On the other hand, there are differences which result from a process of settlement. It seems plausible to assume that the presence of individuals within a sub-area increases the chance that this sub-area will be subsequently selected as a residence by other individuals. The activities of individuals are mutually dependent, and the establishment of one kind of

activity within a neighborhood involves the construction and use of facilities that may be jointly used by other individuals. Initially, there are natural differences among sub-areas that are virtually independent of the process of human settlement, and the chance of a move being made from a particular sub-area to a sub-area lying at some given distance may be greater or less than the chance of a move to some other sub-area lying at an equal distance. As moves take place from period to period, these probabilities would be altered.

In the construction of our model, let us say that an urn and ball schema is prepared for each sub-area containing any chips. Actually, the intention would be to have an urn for each chip, but at this stage the urn schemata would be the same for chips occupying the same sub-area. The experiment, as we conceive it, would consist of a draw of a ball for each chip at the end of each period, the number on the ball indicating the location of the sub-area which will contain the chip during the next period. Each sub-area -- as a possible location of the chip in the subsequent period -- would be represented in the urn not by one ball but by a number of balls. This number of balls would vary from sub-area to sub-area: directly with the degree of attractiveness of the natural endowments of the sub-area; directly with the number of chips presently occupying the sub-area; and inversely with the distance of the sub-area from the locality for which the urn is being prepared.

Let us first consider that aspect of our model which we may suppose to correspond to the natural variation among localities in regard to physical resources. We conceive of a possible array of all the distinguishable types of natural resources. At one extreme of this array would be a class of resources each member of which is found in virtually all sub-areas. These are the ubiquitous resources which are found nearly everywhere and which need never be hauled but short distances. At the other extreme of the array would be a class of resources each member of which is found in only one or very few sub-areas. These are the "strategic" resources. There may be many members of this class, but their respective locations are highly localized and each is found in only a very few places. Members of this class that are widely used are hauled relatively great distances. Between these extremes there would be other classes of resources, ranging from those that are found in all or many sub-areas to those that are found in but few sub-areas. In conformance with our conception of the real conditions which may be observed, we conceive of a distribution of these resources among the sub-areas which is notably skewed. Many sub-areas are thought of as containing only the ubiquitous types of resources that are found in all sub-areas. Somewhat fewer but a relatively large number of sub-areas would contain also some of the resources found in the middle ranges of the array mentioned above. A relatively few of the sub-areas are conceived of as containing one or more of the "strategic" type of resources.

Letting z represent some measure of the quantity of resources included in the natural endowment of the i^{th} sub-area -- perhaps something like the f.o.b. value of the resources --, we conceive of the distribution of z as being also strongly skewed, a relatively large proportion of the sub-areas having small values for z and a relatively small proportion of the sub-areas having large values for z. There being 10 thousand, more or less, sub-areas into

which the total area is divided, there are this number of z values and this number of compositions of the various classes of resources. These we think of as being randomly distributed over the total area so that any region or zone consisting of a large number of contiguous or connected sub-areas will contain a distribution of x values and a composition of the different classes of resources which will be approximately those of other regions or zones of similar size.

So far, we have attempted to describe two initial conditions: first, a variation among sub-areas with respect to natural endowments which would be described by a skew distribution of sub-areas when classified in this respect; and, second, a random spatial distribution of these natural endowments. We have before us, then, a total area divided into many sub-areas each bearing some value of z, and we think of these z values as being randomly distributed over the total area.

Next, let n be the number of individuals located in the i^{th} sub-area. Initially, then, each sub-area will have a value for z and a value for n.

Consider now the making up of the urn for the chips presently located in some given sub-area. Let d be the distance of the i^{th} sub-area from this sub-area for which the urn is being prepared. There are now three variables: z, n, and d. Let k_i be the number of balls placed in the urn for the i^{th} sub-area. In the preliminary construction of our model experiment, we would make k vary directly and proportionately with some increasing functions f(z) and g(n) of the variables z and n and inversely and proportionately with some increasing function h(d) of d. That is, the k for this urn would be made to satisfy the relation $k_i = \frac{A\, f(z_i)\, g(n_i)}{h(d_i)}$. The function $h(d_i)$ would be so chosen that the chance of a move to a given distance zone would vary inversely with distance. Each distance zone, if it contains a large number of sub-areas, will contain about the same relative composition of z values as that found in any other distance zone of large size. But the number of sub-areas contained within a distance zone increases proportionately with distance. Hence, if the chance of a move being made to a distance zone is to be made to vary inversely with distance, then allowance must be made in h(d) to offset the effect of the increasing number of sub-areas as d increases.

Let us assume that in the initial period the total area under consideration is empty of individuals. That is, in this first period the sources of migrants which may possibly be distributed within the area lie outside of this area. For example, in the early part of the 16th century, this continent was virtually empty of Europeans. Migrants subsequently came from central places of Western Europe, and these would be represented in our model by stacks of chips spaced over an area external to the area representing the empty continent. The location of each chip would be subject to change in each period, and there is a chance that some of these moves will carry over into the area which initially is assumed to be unpopulated.

The "experiment" would consist of the operation of this model over a sequence of time periods. In each time period a ball would be drawn from the

appropriate urn for each chip whose location is subject to change, and the location of each chip is thus redetermined period by period. The results recorded for the first period are chance events depending upon the initial conditions: the initial spatial distributions of the z and n values. The results for subsequent periods are chance events depending also upon the happenings in previous periods. The draws of the first period will result in an alteration of the stacks, i.e., in an alteration of the n_i's corresponding to the various sub-areas; and the expectation would be that movements of chips would be made to some of the sub-areas of the initially empty area. In order to add realism to our model, we may allow for an additional source of change in the n_i's. Some systematic birth and death process of the individual chips may be introduced whereby not only do the n_i's change from period to period but the aggregate number of individuals $\sum m_i$ may also be subject to change -- and to accord with the experience of the past this total population would be made to increase.

With each change of the set of n_i's, the system of urns would be adjusted. Period by period the process would develop. For any period, the size distribution of the stacks could be observed -- i.e., the number of stacks containing exactly n chips. If the model is realistically constructed, a particular form of this distribution presumably would be observed for the new area after the process had continued for a time. This corresponds to what we speak of as the process of urbanization of a population. In each period there would be observable a distribution of individual moves classified by length. This would be descriptive of one aspect of the mobility of the population. The spatial orientation of the stacks of varying sizes could be observed, and after a number of time periods there would presumably be observed a particular form of this spatial distribution. That is, for any region containing a large number of sub-areas there would be expected values of the numbers of stacks of the various sizes. During the course of the process, there would be observable a distribution of rates of growth or decline of the individual stacks, and this distribution would presumably also tend to assume some stable form.

In the real population, each individual during his waking life apparently is engaged in a decision-making process. He consciously weighs and judges the expected consequences of alternative actions which are possible under a system of physical and institutional constraints. But in the construction of our model, we abstract from this individual decision-making process[17] -- for this does not pose the problem before us -- and we assume that the results of millions of individuals making rational choices are essentially the same as though the individual movements were chance events. The social problem is posed not by the necessity of an individual making a choice under a given system of constraints but rather by the necessity of a society making a choice among alternative possible systems of constraint. To evaluate a system of constraints which is subject to change and improvement through legislation is to compare the working properties of this system with the working properties of alternative systems. These are population characteristics that are described in terms of limiting forms of distributions such as the four mentioned above. The analytical problem is that of determining the working properties of a model "experiment" which has been made to satisfy the conditions laid down in a system of

(17) Cf. footnote 5, page 165 above.

constraints. This is a problem of analyzing a time-dependent stochastic process. Presumably, legislative policy changes are designed to alter the conditions of the process so as to affect the limiting forms of the various distributions. The acceptance by a society of a legislative reform involves a prediction of the working properties of a system, which in turn involves an analysis of a conceptual model.

APPENDIX

Sources of Tables and Charts and Acknowledgments for Permission to Publish

Table 1: U.S. Department of Commerce, Bureau of the Census, 1950 Census of Population: Preliminary Counts, Series PC-3, No. 9, Feb. 1, 1951.

Table 2: Brush, J. E., "The Hierarchy of Central Places in Southwestern Wisconsin," The Geographic Review, Vol. XLIII, No. 3, 1953. Reprinted by permission of John E. Brush and The Geographic Review.

Figure 1: U.S. Department of Commerce, Bureau of the Census, 1950 Census of Population: Preliminary Counts, Series PC-3, No. 9, Feb. 1, 1951.

Figure 2: Madden, Carl H., "Figures and Charts for 'Some Indications of Stability in the Growth of Cities,'" Bureau of Population and Economic Research, University of Virginia.

Figure 3: Bogue, Don J., The Structure of the Metropolitan Community -- A Study of Dominance and Sub-dominance, Ann Arbor, 1950. Reprinted by permission of Don J. Bogue and the University of Michigan.

Figures 4 and 5: Christaller, Walter, Die Zentralen Orte in Süddeutschland, Jena, 1933.

Figure 6: Brush, John E., "The Hierarchy of Central Places in Southwestern Wisconsin," The Geographic Review, Vol. XLIII, No. 3, 1953.

Figures 7 to 11: Interstate Commerce Commission, Carload Waybill Analyses.

Rutledge Vining

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THE CONCEPT OF A SYSTEM OF CITIES: A COMMENT ON RUTLEDGE VINING'S PAPER

Professor Vining has given an admirably lucid and graphic exposition of several basic features of the distribution pattern of cities. These include population and buying-power densities; density gradients; the rank-size rule; the center and its hinterland; Christaller's hierarchy of "central places"; the concepts of market areas and supply areas; and length-of-haul distributions. We are all indebted to him for the pains he has taken to show all these, not merely as theoretical constructs, but in terms of observed data.

The rank-size rule -- to begin with that -- has long posed a challenge to those who would either explain or dismiss it. To my regret, Professor Vining offers no explanation of this nor of any of the several other approximately-Paretian distributions evidenced in his empirical data; and I must plead ignorance of the extent to which any satisfactory explanation has been provided or attempted elsewhere. I certainly shall not presume to try it myself -- not for the present at any rate. But it may not be amiss to look for a moment at the relation of the rank-size rule to the Christaller concept of a hierarchy of central places of different orders of size and function.

Though Christaller's hierarchy is essentially a deduction from general assumptions and the rank-size rule is based on empirical observation, there are perhaps closer relations between them than one might be led to expect.

Let us look for a moment at the set of dots at the bottom of page 161 and the subsequent discussion on page 164 which sets forth the numerical specifications of a complete Christaller hierarchy of central places based on a series of hexagonal mesh networks. Beginning with the L-system, we see that each successive network consists of three times as many central places as the one before, and therefore necessarily provides individual city "regions," or tributary areas, one-third as big in each size class as in the preceding class.

If one plotted the region area for each class of city against what must be assumed to be the median size rank of each class, the same Pareto distribution emerges as shown in Professor Vining's Figure 1 on page 152. This means that the Christaller system automatically yields a series of city tributary areas arranged according to the rank-size rule. Since we are comparing median size city areas, the system yields not a continuous but a discrete series. But the discrete size grouping of cities and areas in the Christaller system is due to arbitrary simplifying assumptions, and in practice we find a rather smooth continuous distribution of sizes, as shown by the path of dots in Vining's Figure 1.

I might also mention that the Christaller system can be erected equally well (though perhaps a bit less elegantly) on a rectilinear plan, substituting the checkerboard for the honeycomb. The generally rectilinear pattern of roads in considerable sections of this country might lend appeal to that alternative model. At any rate, it makes no essential difference. Each class of city is now 4 times as numerous as the preceding, with tributary areas 1/4 as large; and

in practice the discreteness disappears. The rank-size rule applies just as under the hexagonal system.

However, the rank-size relation implicit in Christaller's scheme is a relation between rank and the size of the city's tributary area, not its population. And what is meant is the largest of the various types of tributary area that a given city has; corresponding to the "most long-distance" function that that city performs. Thus in Christaller's scheme (cf. p.164) a K-city performs not only the K-function for an area of 400 sq. km., but also the A-function for an area one-third that size and the M-function for an area one-ninth that size. It is the K-city's K-area that follows the rank-size rule.

What is it exactly that makes the series of tributary areas of cities follow the rank-size rule? It is convenient at this point to think of the series as continuous rather than discrete. In other words, each city is a size class by itself, and performs some function that is performed by no smaller city but by all larger cities. Now if we take, say, the 17th biggest area, we can consider it as one of the group of the 17 biggest. With respect to the function exclusively shared by these 17, the whole country is parceled out into 17 equal areas. Similarly, the 16th biggest is one of a group of 16 equal areas blanketing the country with respect to the function which only the 16 biggest cities perform. Obviously the rank-size progression is implicit, then, in the concept of each city's area being determined by equal sharing with all larger cities.

This concept would have to be probed more deeply to discern why the rule seems so often to apply to population too. The considerable degree of empirical correspondence to the rank-size rule for population may suggest the proposition that the populations of cities tend to be directly proportional to their maximum hinterlands. ("Maximum" in the sense previously explained.) This could be explored further, introducing both empirical findings and theoretical analysis. For example, Professor Vining claims to find a characteristic logarithmic function for the tapering-off of population density with increasing distance from a center, and likewise a characteristic logarithmic curve for the frequency distribution of lengths of haul of goods from or to a given center. Might these observed facts be made to enlighten the relation between hinterland size and city size?

I should like to urge, though, that empirical measurement is not enough. A very considerable amount of theory would be needed to establish the relations between the various sets of quantitative relations described by Professor Vining in his paper; a further considerable amount would be needed to develop an integrated "concept of a system of cities."

That, by the way, happens to be the title of Professor Vining's paper, but I still don't know just what the concept is. The promise made in the opening paragraph on p.147 seems not yet fulfilled. I fail to find either the "comments in regard to the task of finding an analytical explanation," or the "comments on policy considerations." Are those reserved for later papers?

If I may return for a moment to the rank-size rule, it raises the question of the delimitation of a system of cities. Take the distribution of U. S. cities

shown in Table 1 and Chart 1, for example. It includes the biggest 157 cities, and follows the rank-size pretty well. But what happens if we remove one or more cities from the top of the list, and consider only the rest? The formula immediately ceases to fit. We cannot start with any city other than New York.

This suggests that in some sense (as yet certainly not well understood), the cities of the United States constitute a self-contained "system" to the extent that conformance to the rank-size rule is a criterion. But could we throw the cities of Canada or Mexico into the series and still have it fit? Do the cities of Canada or Mexico by themselves fall into the rank-size pattern? What delimits a "system" of cities? The Christaller hierarchy does not seem to provide an answer either, since the ascending series of orders of places could be carried on up to the largest city in the world or else arbitrarily chopped off at any given smaller size or confined to a smaller area.

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